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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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BRIEFLY TOLD.

DEATH OF MR. THOMAS F. ROWLAND.—We are obliged to report the death of Mr. Thomas F. Rowland, founder of the Continental Iron Works, an Engineer of international reputation and prominent in the American gas industry for 50 years. His death occurred Friday, the 13th inst. He was in his 77th year. Next week we propose to give some record of his important and successful work.

THIRD ANNUAL MEETING, NATIONAL COMMERCIAL GAS ASSOCIATION.—Secretary Bigelow, of the National Commercial Gas Association, is out with the announcement for the third annual meeting of the Association. It is to be held the 8th, 9th and 10th days of January, 1908, and headquarters will again be in the Hotel Cadillac, Broadway and Forty-third street, New York; the meeting room will also be in the hotel. The programme arranged for is an excellent one, 14 separate numbers being listed. These, besides the President's address, include two addresses, respectively, by Dr. A. C. Humphreys, who has elected to speak on "The Commercial Side;" and by Mr. H. R. Sheldon, Vice-President of the Sheldon School, whose theme is "The Salesman's Personnel." While the titles of the other communications, and the names of their authors as well, indicate for all matter of interest and value, it is noteworthy that two are on subjects novel for the consideration of gas men in stated meetings. For example, Mr. F. H. Barnitz, of the New York Consolidated Gas Company, will speak on "The Use of Mechanical Devices in the Accounting Department of a Gas Company;" and Mr. E. N. Wrightington, Secretary Boston Consolidated Gas Company, is to handle the question of "The Conducting of Gas Company Employees' Meetings and Kindred Matter." The latter communication will not only be on a novel subject, but should be further noteworthy in that there is little room for doubt that it will attract greater attention than ever to the merit that is in organizing the employees for closer companionship when the days' work is done. It was rather wisely decided, on account of the continued and widespread financial depression that rules, not to hold an exhibition of gas appliances this year, with the Association directly in charge thereof. However, one may easily understand that the temper of nearby gas appliance manufacturers will not permit the convention to adjourn ere its attendants will have been shown over exhibits of one kind or another in a sort of unofficial displaying. President Clark, Secretary Bigelow and the Committee on Ways and Means are to be congratulated respecting their attention to the preliminaries, and those proposing to be present should pay heed to the Secretary's admonition that "Accommodations should be reserved at once, as New York is at the height of its attractiveness just at the season of our convention, and rooms should be spoken for in advance."

OTHER MEETINGS THAT HAVE BEEN HELD.—This has been a busy month with other Societies of gas men than those of the "regular" sort, if that term may be used. The annual meeting of the Society of Gas Lighting was held in the Hotel Astor, New York, the afternoon of the 12th inst. As usual, it was enjoyed and enjoyable in every sense. No change was made in the executive, and the annual dinner was the occasion for a display of hearty good fellowship that knits this Society so harmoniously and fraternally. The meeting of the New England Section of the Illuminating Engineering Society was held in the Edison Building, 39 Boylston street, Boston, the evening of the 18th inst., with a good attendance. The paper presented and read by Prof. William L. Puffer was on "Variables of Illuminating Engineering." The Professor treated the subject in good manner; in fact, he should be (and likely did) feel quite elated over the spirited discussion that it evoked. The annual meeting of the Section will be held on the 14th prox. We note that the regular ballot provides for the promotion of Secretary J. S. Codman to the Chairmanship, with Mr. R. C. Ware named as Mr. Codman's successor to the Secretarial desk. Messrs. W. H. Blood and T. H. Piser are named as Managers. The meeting of the Pittsburgh Section of the Illuminating Engineering Society was held in the Fulton Building, Pittsburgh, the evening of the 18th inst. At this meeting an excellent paper on "Fixture Designs" was jointly presented by Messrs. V. R. Lansingh and C.W. Heck. To conclude the series, at least so far as we have official advices, is to say that the Philadelphia Section held its December session the evening of Friday, the 20th inst., in the assembly room of the Philadelphia Electric Company. The feature of the evening was a lecture on "The Light Spectrum," by Prof. H. Clyde Snook. His attention-compelling narrative was profusely illustrated by means of

LIBRARY OF CONGRESS. DEC 23 1907 484023 SMITHSONIAN DEPOSIT.

lantern slides, which added much to the force of the text. The Chicago Section held its session the evening of the 12th inst., in the German room of the Grand Rapids Hotel Restaurant, and even if the proceedings were said to be purely informal, it is nevertheless a fact that the subject for discussion, which concerned the "Special Lighting of Downtown Streets," was so practical and so interesting that when the meeting adjourned it was voiced without dissent that it had been the best one the Section ever conducted. The discussion was based on the relative merits of incandescent, common arc, luminous arc, flaming arc, gas mantle cluster or gas arc, and Nernst lamps.

CURRENT COMMENT.—

GENERAL JOHN P. HARBISON has resigned the Presidency of the Electric Gas Company, of America, and also from its Board of Directors.

PROF. L. P. KNIGHT, Instructor in Organic Chemistry, Rose Polytechnic Institute, Terre Haute, Ind., recently escorted the members of the Junior Class in that study through the plant of the Citizens Gas Company, of Terre Haute. The operation of the coal and water gas systems was thoroughly explained to the youngsters, who were much impressed by what they saw. These visiting schemes are surely productive of much good to the industry as well as to the students.

EARLY this month the Public Improvements Committee of the St. Louis (Mo.) Common Council set a date for a public hearing over the bill to reduce the gas rate in that city to 80 cents per 1,000 cubic feet, which the authorities of St. Louis have been tinkering over for some time. The interest in the matter was so pronounced that not a "hearee" was on hand at the appointed time.

[Prepared for the JOURNAL.]

Prevention of Freezing of the Water in Gasholder Tanks and Cups.

By MR. E. H. YORKE, Portland, Me.

In a consideration of the different items of expense which enter into the cost of gas, that which is the subject of this article will be found one of no mean importance. Whether this cost has been as low as conditions would permit must be determined by the individual superintendent; but it will doubtless be admitted that, in the majority of works, there has been an impression in the mind of the superintendent that more or less steam has been wasted in this direction, which waste perhaps was unavoidable and due to a lack of proper means for accurately determining just how much steam was necessary in order to keep the water in the tanks and cups from freezing. The employee to whom the duty of keeping this water from freezing was assigned doubtless himself felt that he was admitting more steam than was necessary, but concluded that it would be best to be on the safe side, if for no other reason than to avoid a reprimand. The need, therefore, for a better and more economical system than that generally employed becomes apparent. It was for the reasons stated that the writer gave this detail some study, with results which he feels furnishes a sufficient apology for drawing attention to it.

In seeking for an axiom covering the basic essential, the following readily suggested itself; *e. g.*, that *the volume of steam admitted should be in exact ratio to the atmospheric temperature.* A basic principle having been established, the idea naturally suggested itself to employ some metal or liquid to automatically control the supply of steam. As most automatic regulators are unreliable, it was deemed best to turn to a system of hand regulation, but of such arrangement that the necessity for the employee exercising any judgment would be eliminated, and he would simply follow guiding rules. Such an arrangement has been in use for some months at the works immediately under the charge of the writer, and as it has proved most satisfactory he feels it to be not much less than a duty to present the idea to his fellow Superintendents.

The device is simply a manifold in which are inserted ¼-inch steam cocks having small round way openings. These manifolds to the different holders are grouped together in one room. A large dial thermometer is located outside the window, in a ventilated box. An instruction card hangs on the wall by the manifold. This card gives the number of cocks to be turned on at the different temperatures, ranging from 32°, and each multiple of 4° below the freezing point. While the plan is simplicity itself, the results which are secured through its use make it an important improvement on the old and wasteful method heretofore generally employed.

[Continued from page 1061.]

PROCEEDINGS AMERICAN GAS INSTITUTE, SECOND ANNUAL MEETING, HELD AT THE NEW WILLARD HOTEL, WASHINGTON, D. C., OCTOBER 16, 17 AND 18, 1907.

SECOND DAY—MORNING SESSION.

REPORT OF THE COMMITTEE ON METHODS OF TAKING CANDLE POWER OF GAS.

[For the introductory sections of the Report, see *ante*, p. 1060.]

Ventilation.—If any wall of the photometer room is formed by a wall of the building in contact with the outside air, that wall should be jacketed with non-conducting material to make it readily maintain the same temperature as those sides communicating with the interior of the building. No room having walls of considerable difference of temperature can be free from drafts.

The photometer room is in best condition when built in the middle of a room that is warmed and well ventilated, and not used for any purpose tending to vitiation of its atmosphere. In this case the photometer room may receive for its proper ventilation a supply, in cold weather, of pure, warm air from the outer room, while its sides are exposed to a uniform temperature on the outside and to a uniform temperature on the inside; and in warmer seasons it is protected from the direct rays of the sun.

While the air in the photometer room is best supplied from the outside room the flues discharging the vitiated air from it may open into the outside room again if the height of this room is not less than 10 feet above the ceiling of the photometer room. In this case the openings in the ceiling of the photometer room should extend the full length of the photometer table and should be light-tight.

If the height of the outside room is less than this limit, the ventilation of the photometer room should be carried on by means of light tight ventilators controlled by a damper. In this case the openings in the ceiling of the photometer room should discharge into a box, to which these ventilators are connected, and the ventilators should be carried through the roof of the outer room.

The air may be admitted to the photometer room through suitable openings in the outer sides of the walls or partitions, thence downward with a sufficient offset to exclude light, and then into the room through registers set in the baseboard. These openings should extend around the entire room. The total area of the register openings, for a room of the minimum size given herein, should not be less than 10 square feet, made up of 24 registers, 6 inches by 10 inches, or their equivalent. For the purpose of light and ventilation when gas pipes are to be disconnected, and for cleaning, two or more light-tight shutters, opening into the outside room, should be provided. Such a room will permit of the continued presence of 2 persons, a 5-foot per hour gas flame of the pentane lamp. and yet maintain a low degree of vitiation, without drafts. (See Appendix A, Part 2.)

Vitiation Effects.—The charts of Appendix A show the relative effects of vitiation on approximately 22-candle power mixed coal and water gas, and on some of the standards of light that are now in use. The percentage of loss in candle power of the gas flame being less than that of any of the standards shown, we can safely assume that any vitiation of the atmosphere beyond the normal will cause the candle power of the gas flame to show higher than it would if measured under normal conditions. This, of course, presupposes that the formulæ corrections for humidity and carbonic acid content as supplied to the flame standards have not been used. These charts are also interesting, as showing that the divergencies between the gas flame and the candles are greater than between the gas flame and the pentane lamp or the Elliott lamp.

The photometer room, therefore, should be supplied with an abundant quantity of air, uniform in purity and in temperature, from the outside room, the temperature of which may be kept uniform either by the indirect or hot air system of heating. If the location is such that there is no one present at night, a gas stove or electric heater could well be employed to maintain the temperature at the desired degree during off hours.

Humidity Effects.—In those climates in which the heat of the summer is accompanied by high humidity, there is introduced a problem which is difficult to solve. A very disturbing factor in correct candle power determinations is the change in the quantity of water vapor present in the air. While in the winter the humidity will be below normal at the temperature of the photometer room, it can be brought up to normal; but in the summer, the problem is to reduce the humidity. The introduction of methods of cooling the air during

the summer months, by which the humidity may be controlled, appears to be essential for correct work.

Formulæ for correcting the candle power of the pentane and Hefner lamps for variations in the humidity and carbonic acid content of the atmosphere supporting combustion of their fuels have been deduced empirically by Mr. Paterson, of the British National Physical Laboratory, and Dr. Liebenthal of the Reichsanstalt. In these cases, however, great care has been observed to keep the fuel of these lamps exactly constant in composition.

We could not expect to apply any formulæ for these atmospheric constituents to a flame of varying composition such as changeable gases requiring different quantities of air. Consequently, when we compare a gas flame against another flame standard, we must either have normal atmospheric conditions in the room or we must know that these atmospheric conditions influence the flames of the standard and the gas exactly alike. To compare a gas flame against an electric lamp normal atmospheric conditions are imperative, otherwise an error of as much as 10 per cent. may be introduced generally against the gas flame. The photometer room and laboratory of the Bureau of Standards at Washington are equipped with cool, brine coils, over which the air to the photometer room is passed, thus reducing the quantity of water vapor.

The range of absolute error which is attributable to this humidity cause alone is set forth in Mr. J. B. Klumpp's "Notes" in the Report of the Research Committee of the American Gas Light Association, in 1905, in which the pentane lamp value is shown to be subject to a total variation of as much as 25 per cent. between the extreme ranges of humidity in Philadelphia in a year.

Temperature Control.—The temperature control of the photometer room is a matter of prime importance. Not only must the pipes conducting the gas to the photometer room be protected from chilling below the minimum temperature of the gas in the mains, but fluctuations in the temperature of the photometer room during the times when the readings are not being taken constitute a cause that leads to frequent inaccurate determinations.

Gases depend for their illuminating quality more or less on the condensible vapor. When a gas passes through a pipe the sides of the pipe become coated with a condensate from the gas that will, if the temperature and the gas do not change, remain in equilibrium with the vapors in the gas. In other words, there will be no interaction between this condensate and the vapors in the gas. If the temperature of the condensate changes even slightly, it will no longer be in equilibrium with the vapors in the gas; and there will be an absorption of the vapors of the gas if the pipe gets colder, or there will be a yielding up of the vapors to the gas if the pipe gets warmer, resulting in a temporary decrease or increase in the candle power.

What is true of the pipe is particularly true of the photometer meter. The meter water is also influenced through the fact that the solubility of benzene vapors in water is affected by temperature. Like ammonia, so with benzene vapors; cold water will absorb more of them than hot water will. It is for these reasons that a sudden increase in the temperature of the photometer room will give temporarily a higher reading of a gas flame.

In Appendix B is given the result of the experiments to show the influence on the candle power of passing gas through meters in which the temperature has been changed. An even temperature of 75° F. in the photometer room throughout the year is desirable.

Construction.—The photometer room may be constructed of metal, such as corrugated or stamped iron, or of wood, or of brick, or tile. The photometer room shown in plate 1 of Appendix A is shown as made of sheet iron.

Photometer.—The Committee recommends the use of the 60-inch bar of the improved Letheby type, and does so without prejudice to the 80-inch or 100-inch bars. After diligent inquiry among the gas companies, it is believed to be their tendency to equip themselves with 60-inch bars, and they seem to have been governed by the consideration that more 60-inch bars of modern design are being used than any other.

Of 98 sets of questions sent out to the larger gas companies, 73 companies replied; of these 62 companies use bar photometers. They have in use 83 bar photometers, of which 37 are 60-inch, 29 are 100-inch and 4 are 80-inch bars. The advantages of the 60-inch bar are:

1. That, being shorter, it requires less space.

2. That the two light sources usually compared in plain gas photometry are at such relative distances from the disk as to give it the best theoretical illumination for easily comparing the star or other figure on the disk,

Assuming as normal for America a 10-candle power standard and a 20-candle power gas, the disk box at correct setting will, on a 60-inch bar, be about 2.07 feet from the 10-candle light; and on a 100-inch bar it will be 3.45 feet from the 10-candle light. The setting being correct, the illumination on both sides of the disk will be equal. The human eye has objects best illuminated to suit its vision, that is for sensitive discernment of differences in appearance, when that illumination is from 2 to 3 foot candles.

Computing, therefore, from the above figures, we find that for the 60-inch bar the disk has an illumination of $\frac{10}{(2.07)^2} = 2.34$ foot candles; and that for the 100-inch bar the illumination is deficient, being only one-third this, or $\frac{10}{(3.45)^2} = .84$ foot candles. The 100-inch bar with a 10-candle power standard is well adapted for the determination of incandescent mantle lights where the range is from 60 to 100 candles.

The objection may be urged against any form of straight bar photometer, such as the Letheby, that while the standard lamp used had its value assigned when it was at one distance from the disk, yet in the operation of taking varying candle powers the standard lamp is used at varying distances from the disk, and the nearer the lamp is to the disk the greater is the light area of its flame at the disk. In some cases, such as the Edgerton Standard, this has been met by an accurate determination of the effective center of the Edgerton standard flame, which was then placed in the position of the standard light source. The effective center of the circular flame of the pentane lamp is at a point forward of the geometric center, a distance equal to one-third the radius of the flame; so that if the lamp is set up with its effective center 30 inches distant from the center of the bar, the effect of varying the distance of the disk from the pentane lamp will be neutralized and accuracy maintained.

The art of photometry of gas flames has been much advanced by the work of the Gas Referees in London and their associates. These gentlemen, acting as arbitrators between the gas companies and the municipal authorities for many years, have brought to bear on most of the questions that have presented themselves—and it would seem that almost every possible question had presented itself—a high degree of technical knowledge and practical experience. Their decisions and the results of their investigations are entitled to the highest respect, and the investigator who differs with their findings should realize that such responsibility must not be assumed lightly. One of the limitations of the work of the London Gas Referees must be kept in mind—they deal with London gas as burnt in the city of London. The methods and apparatus used by them may not be practicable for gases of wide range in candle power.

The Gas Referees of London and their associates made a thorough study of the advantages and peculiarities of different types of photometers prior to the adoption of the new table photometer in 1898. This photometer is a modified form of the Foucault, and is similar in principle to that used in Paris. The objection just cited is here met by fixing the positions of both standard and test light, and also of the disk, or "photoped" as it is called. The 10-candle pentane lamp was placed 1,000 mm., and the London Argand burner 1,265 mm., respectively, distant from and on the same side of the photoped. All other distances of importance were similarly fixed with exactness, so that it would be possible to turn out a series of uniform instruments. The adjustment of equality of the disk's illumination was gained through varying the rate of flow of the gas, and this equality is judged from the rear of the photoped by transmitted light. Such a method was not flexible, however, as it would not easily permit the testing of gases varying widely in candle power, nor the use at the same distance of both Argand and flat flame burners. We find, however, that in the 1907 "Notifications," the Referees have returned to the principle of movable parts; but in this case it is the test flame which is made to move and not the disk. We are not able to persuade ourselves that this is the best method of meeting all the difficulties.

It seems to me that, as one requisite of accurate photometry is that both flames shall be as quiet as possible, it is a wide departure from this accepted standard to oscillate the test flame to and fro during a determination of the gas burning through it. It was desired that tests should be conducted to find whether the "Table Photometer" in operation had advantages over the type which the Committee recommends. For this purpose one was imported from London. It was set up in a room 27 feet 9 inches by 18 feet 6 inches, and 16 feet high, containing a 60-inch bar photometer and a 125 cubic foot gasholder. In this way it was possible to furnish the identical gas to each photo-

meter and to maintain all temperature and atmospheric conditions equal.

The photometrists, after considerable practice to enable them to do consistent work on the "Table Photometer," report that while its design is to give greater convenience to the operator and permit him to remain seated during a test, they are not able to make a setting with as great readiness nor within as narrow limits as with the other photometer. As a consequence, there is a wide disagreement of the readings by the same individual, although the average by the two methods is not far from agreement. More practice may bring greater skill, but at present they do not see any refinement in observation by comparison of the two fields on the photoped. Apart from this criticism, the "Table Photometer" is the logical development toward the elimination of several disturbing factors, such as "personal equation" and varying distance of standard from disk.

Two other points should be mentioned while speaking of the possibility of adoption of such a "Table Photometer" in American practice. It would not be feasible to place more meters upon such a table for the purpose of testing different gases on a works' photometer, because the space on the table near the observer is already filled. Secondly, it would be advocating the abandonment entirely of the present photometric equipment in this country, for we are unable to learn of the use of such "Table Photometers"

The Committee is of the opinion that, while advocating the continued use of the bar photometer, yet every means contributing its greater accuracy should be encouraged. To this end we recommend the "substitution" method in testing gas.

It is known that in most cases if two lamps, A and B, prove equal when A is at the left of the bar and B is at the right, yet they may differ slightly when B is at the left and A is at the right. This may be due to personal equation, to air drafts, to unequal reflecting surfaces or other contributing causes. If, however, A is known to have a standard value, and the desire is to test the candle power of the gas against A's units, then substitute A in the place that will be used by the gas and evaluate B in A's terms in the position which it (B) will continue to occupy. All that is now desired of B is that it shall continue constant, yielding always the value given it by A's units. A is then taken away and the gas is swung into the position which A occupied. It is here subject to exactly the same environment that A had, and, through comparisons with B, obtains its candle power in terms of A. Furthermore, A, being the standard of reference, is used least and will be preserved longer.

The installation of photometric apparatus necessary for the exact, or approximately exact, valuation of a gas flame requires a stable equipment. Attention must be given to many details of the care of the gas in its approach to the room and in its treatment in the room. We call attention to the grave sources of error capable of the widest ranges of injustice that are introduced when these details are not observed. The determination of the candle power on portable photometers must be accepted with the greatest caution. Of this class of photometers it must be said that accuracy is often sacrificed to convenience of handling. The usual sources of error in a portable photometer are as follows:

1. The photometer is closed in and thus supplied with vitiated air; also under this condition such air as the flames get is supplied through small crevices and accompanied by drafts.

2. The body of the photometer is not rigid and the movement backward and forward of the disk box causes vibration of the flame.

3. The disk box is set so near the bed of the table that the dust gathering upon the table may easily become appreciably a reflecting surface.

4. Many of these portable photometers are without a governor or without a device for measuring pressure.

5. It is a common practice to use rubber tubing in connection with them, such tubing having the property of absorbing benzene vapors and reducing the candle power.

6. A photometer equipment comprises a proper preparation of room as to ventilation and temperature, careful guarding of the gas against chilling and other precautions against error that will not be found if the photometer is set up anywhere and everywhere.

Piping.—The temperature of the gas in the pipe conveying the sample from the main to the photometer should not be allowed to fall below the minimum temperature in the main. The service pipe should be taken from a point not above the middle of the main, and where it is carried under a water tight pavement should have only a slight drip back to the main. It is better to drip the piping toward the cellar, thereby securing more cover to the service pipe than to the main. In the cellar of the building it should be protected carefully against chilling. The pipe should run as direct as possible to the photometer and should be covered with non-con ducting covering.

Several companies have adopted the use of cooling coils on works photometer, through which the gas passes before entering the photometer meter, thus securing at all times of the year the candle power of the gas at a constant temperature. By observations with the hygrometer (as devised by Bond and Tutwiler, of the Philadelphia Gas Works), at the Testing Station, the temperature to which the gas has fallen before reaching the testing station photometer may be determined, and the fall in candle power, due thereto, may thus be anticipated at the works.

The use of pure or vulcanized rubber hose for conducting gas to a photometer is condemned as decreasing the candle power of the gas.

Governor.—In order to secure exact measurements on the photometer meter, the gas in the inside of the meter drum should be under uniform pressure. For this purpose a governor should be placed on the inlet to the photometer meter. The Committee recommends the use of a dry governor, which, while somewhat less delicate than a wet governor, avoids the two objections to a wet governor; namely, first, the more attention that it requires and the introduction of fresh water from time to time which must be saturated before a correct reading is to be made; second, the wet governor acts as an averaging tank and will not show as rapidly as the dry governor changes in the candle power.

A dry governor, smaller in size and capable of delicate adjustment, should be placed on the outlet of the photometer meter to still further reduce the pressure supplied to the burner, and to obviate small fluctuations caused by the dipping of the meter partitions into the water.

Forty-two companies report using dry, and 18 wet governors; those using governors at inlet only, those at outlet only, and those at both inlet and outlet are about equal in numbers.

Meter.—The Committee recommends the adoption of the $\frac{1}{10}$ cubic foot per revolution wet photometer meter, unencumbered by a superimposed clock. The rate of flow of the gas should be determined by a detached watch or clock. With a $\frac{1}{10}$ cubic foot per revolution meter, the gas is being burnt at the rate of 5 cubic feet per hour when the meter makes one revolution per minute. The observer can watch the meter dial with his eye and snap the watch at the completion of a revolution of the meter hand. He then reads from his watch the number of seconds required for a revolution.

The candle power computer is based on the use of the $\frac{1}{10}$ cubic foot, per revolution meter.

The speed of the drum throughout a revolution should be as nearly as possible exactly uniform. Should the movement of the meter hand appear erratic, a leak should be suspected, and a test made to ascertain if this true. It may be occasioned either by friction of the circumference of the drum or by its shaft, due either to a deposit of sediment below the drum or to dryness of the stuffing box. Either cause will produce an erratic motion and be accompanied by fluctuations of the water in the gauge glass.

Clear water should be used in the meter, and it is at the correct height when the bottom of the meniscus is at the height of the pointer on the glass. The drum should revolve freely with a $\frac{1}{10}$-inch pressure.

The meter should not be connected rigidly with wrought iron pipe at the inlet and outlet, as such connections render the leveling screws inoperative without straining the meter. Lead connections are preferred. It is best to set the meter and level it first and then bend the connections into place.

When gas from more than one supply is to be measured in sequence on the photometer, a separate meter should be provided for each kind of gas, in order to secure, in the shortest interval of time, accurate determinations. For instance, if a higher candle power water gas is passed through a meter which has previously been measuring coal gas, a considerable time must elapse before the water in the meter gets in equilibrium with the vapors in the higher candle power gas. Until this is accomplished the reading will be too low.

In a works manufacturing a mixed gas, in which the candle powers of the coal gas, the water gas, the mixed gas at inlet and the gas from the street governor outlet are to be measured, four separate meters are recommended.

The photometer equipment should include a $\frac{1}{10}$ cubic foot glass bottle, such as are supplied by photometer makers. Its capacity should be derived from a cubic foot bottle certified by the Bureau of Standards at Washington.

A duplicate meter, proven correct by a cubic foot bottle, should be

always on hand for releasing the meter in use to be tested when any cause for suspecting its accuracy arises.

Five companies replied that they did not correct the volume of gas burned to 60° temperature, and 4 make no corrections for barometric pressure.

Forty-two companies use $\frac{1}{10}$ cubic foot meters, 16 use $\frac{1}{5}$ cubic foot meters, others use both.

Stop Watch or Clock.—Stop watches are generally unsatisfactory because of readiness to get out of order. A good stop watch in individual cases is reliable, but for frequent work it is expensive to keep in repair. A watch that would lose 5 minutes a day at a uniform rate would introduce an error of less than a third of 1 per cent. An electrically controlled clock of substantial workmanship, placed in a safe position and operated by 3 keys, for the purpose of starting, stopping and setting back the hand, is on the market and forms a reliable instrument.

The Swing Bracket.—The burner should be carried on a swing bracket supplied with a plumb bob for placing the flame at the proper distance from the center of the bar. A swing bracket will permit of the placing of the pentane lamp by the substitution method. For exact alignment of the flame 2 plumb bobs should be used, one on each side of the flame at right angles to the direction of the bar and each 30 incles from its center. The flame is adjusted in final position by sighting across these lines.

Disk Box.—The disk box containing the disk is referred to by many writers as the "photometer." Stine says: "The act of measurement involved in photometry is confined to observations of the illumination of the lights compared upon some form of screen; and taking this as a basis, the photometer is the screen with its accessories."

The Committee recommends the Leeson Contrast Disk as being the simplest disk to reproduce, keep clean, read without fatigue to the eye, and not wanting in accuracy. In gas photometry the slight irregularities of the meter, the possibility of slight drafts, the dancing of the gas flame itself, make the use of the Lummer-Brodhun Disk fatiguing to the eye. Tests made by two sets of observers on the same gas, reading against an electric standard—one set using the Leeson disk, and the other Lummer Brodhun contrast disk—proved that under skilled observers they were equally accurate.

The human eye fatigues perceptibly with a Leeson contrast disk after 8 hours of work, and much more quickly when reading with the telescopic disk.

Twelve companies report the use of the Bunsen or grease spot.

Twenty-four companies use the Leeson contrast disk.

Twenty-four companies use the disappearing star.

Eight companies use the Lummer Brodhun, of which seven are disappearing and one contrast.

Burner.—The kind of test burner that should be used has been the subject of much controversy. It is frequently specified with the candle power of the gas to be produced.

The London Gas Act of 1905 contains the following clause:

"CLAUSE 3.—The Gas Referees shall from time to time prescribe the burner for testing the illuminating power of the gas supplied by the company and the chimney (if any) to be used with such burner. The burner so prescribed shall be of such pattern (not being an incandescent or similar burner) as shall be practical for use by the consumer; and the burner and chimney (if any) shall be the most suitable for obtaining, and in making the test shall be so used as to obtain from the gas when consumed at the rate of 5 cubic feet an hour the greatest amount of light."

The English view is thus summarized editorially in the London *Journal of Gas Lighting* for July 14, 1903: "The fundamental law of gas testing for illuminating power is that this shall be done with the burner best suited for the purpose, used in the most favorable way for the gas, provided only that the burner itself shall be one which consumers can use if they please. Except to the wilfully blind, there cannot be the smallest mistake as to the intent of this enactment, which has been justly styled 'the charter' of the illuminating gas industry."

The Gas Act referred to above embodies the conclusion arrived at after a thorough discussion of the subject by the London County Council (representing the municipality) and the gas companies. It will be impossible here to even outline the arguments presented on both sides; but the question seems to have been settled for the future by the adoption of the Metropolitan No. 2 Argand burner, one of which is here on exhibition.

It consists of a carefully made Argand burner, fitted below with an air shutter by which the supply of air to the interior of the flame may be regulated. The burner as constructed makes a marked gain in efficiency over the Sugg D burner for gases of low quality.

The Committee calls special attention to that clause of the London Gas Act of 1905, describing the kind of burner that should be used in testing the candle power of gas, as cited above; and you are asked to note that this is an act of legislation and not alone the views of the gas companies, and that on this subject the municipal officials and the gas companies are in accord.

On the Various Working Standards in Present Use.—In the reports received from the various gas companies of America, we find the following working standards to be in use:

A. British Candles—of several importations. Used by 31 of the 40 municipal and State inspectors and by 41 gas companies.

B. Edgerton Standards. Used by 18 gas companies; no municipal or State inspectors.

C. Hefner Lamps. Used by 1 municipal inspector and 5 gas companies.

D. Electric Incandescent Lamps. Used by 2 municipal inspectors; no gas companies.

E. Elliott Lamps. Used by 11 gas companies.

F. Pentane Lamps. Used by 31 gas companies and 3 municipal inspectors.

G. Jet Photometers, variously manipulated. Used by 28 gas companies, 20 of which also use bar photometers.

We should note that each of these standards is the product of incandescent carbon, and that their variety occurs through the effect of the media in which incandescence is produced.

The electric lamp produces incandescence of fixed carbon particles in a vacuum by direct molecular agitation by an electric current. It is not, therefore, affected by variations in the surrounding air, and is not to be recommended for photometry of gas flames.

In all the others the carbon particles are dissociated in a free stream and are rendered incandescent by the direct application of heat through a combustion of gases whose oxygen supply is the surrounding air. Their flames are either a single jet or a series of jets arranged in flat or circular form. These flames are either freely open, partly directed, or wholly inclosed and directed by a chimney.

The attempt to preserve their luminosity constant is made in either of two ways: First, by a uniform consumption of fuel; second, by the maintenance of a constant flame height. But so long as the flame and its temperature are dependent upon a surrounding air of varying quality, the luminosity of the free carbon particles will also vary, for this luminosity varies as the fifth power of the absolute flame temperature.

From this and the fact that humidity in the air exerts the greatest effect upon flame luminosity, it is clear that the real cause of variation in the several standards is the change in flame temperature. This knowledge should aid us in the selection of a standard; for we should choose that one which, while otherwise constant and reproducible, comes nearest to being affected by atmospheric changes exactly as our test flame is affected. In other words, we should expect it to be a flame of similar dimension, temperature and air consumption to our test flame. These conditions in the list of standards given are nearest met by the 10-candle pentane lamp, as shown in the vitiation tests already referred to.

It may be well here to define the ideal working standard for gas photometry, as conceived by the Committee:

1. The lamp should be readily portable, of simple construction and unvarying dimensions.

2. It should have an independent fuel, reasonable in price and readily procurable, which should be of definite chemical composition, with a fixed boiling point.

3. The flames should be of the same order of luminosity as the test flames, of a similar color, fed without a wick, at a constant pressure, through a constant opening. No chimney should surround it.

4. The lamp should be burned in a quiet room of uniform temperature and be supplied with pure air of the same temperature. After reaching thermal equilibrium, its flame height should be set and all the conditions named above having been complied with, the flame height and flame value will remain unchanged for that particular atmospheric condition.

5. The flame of the standard lamp should be influenced in percentage of its normal value by atmospheric changes in exactly the same degree as those changes influence the value of the gas flame to be measured.

A Brief Description Follows of the Several Working Standards Mentioned.—Of the 41 gas companies using candles, 24 state that they are satisfied and 16 that they are not.

(A) A history and discussion of the standard candles is presented in Appendix D.

It presents the indictment against the practicability of use of the English Standard Candle as a standard of light:

1. Because it will not always burn within the prescribed limits of time. In warmer climates it frequently burns outside of the prescribed limits more than 50 per cent. of the time. In many of the cities of this country below the 42° parallel of latitude, it is necessary to keep the candles on ice or in ice boxes. The rejection of photometrical observations because of candles burning outside of the prescribed limits makes an almost prohibitive bar to systematic work.

2. When burning within the prescribed limits it yields a light of varying intensity, due not only to the apparent failure to make candles conform precisely to the specifications, but to the fact that even if the specifications were exactly fulfilled in several candles, their light would not be uniform; and furthermore, to the effect of atmospheric conditions upon that light.

Any attempt to exactly measure these influences, such as humidity, would, of course, be greatly complicated by the knowledge that the candle, in the composition of its fuel, the wick and its mechanical construction, introduces elements of variation not to be found in the pentane and Hefner lamps.

We are not prepared to give a definite formula for the effect of water vapor on candles, but we shall put forward a tentative one. As Paterson has used the formula: Candle power = 10 + .066 (10-e), for the 10-candle pentane lamp, where "e" is liters of water vapor per cubic meter of dry air and 10 is the normal number of liters, so for the B.T.S. candle in Philadelphia we should say: Candle power = 1 + .0087 (9.3-e) where 9.3 is the normal liter of vapor per cubic meter of dry air.

In this connection it is interesting to compare the average values of three kinds bought as standard sperm candles, obtained from 3 American cities of differing climates where they are used. These we shall call A, B and C. A candles were 12 to the pound; B and C candles were 6 to the pound. The comparison was made against an electric incandescent lamp of constant light value; and the value of each candle is the mean of all determinations made during its complete consumption. Conclusions are drawn from those tests made under similar atmospheric conditions.

Liters Water Vapor per Meter Dry Air.	A.	B.	C.
18.....	.950	.924	.929
22.....	.936	.902	.918
23.....	.903	.886	.851
Average..	.930	.904	.899

While a variation from the normal rate of consumption of sperm of 5 per cent. is usually adopted, there seems to be no sufficient reason why this allowable variation should not be extended to 10 per cent. in seasons of high temperature and humidity.

While the normal water vapor content of the air for the year at the place of test is 9.3 liters per cubic meter of dry air, the tests made above were in an atmosphere of higher moisture. From this knowledge gained in these and a great many other experiments of the effects upon candles of water vapor per cubic meter, the candles would be burning abnormally if they did fall within the same limit. Corrections, applied when the time of burning was 3 per cent. faster or 10 per cent. slower than the normal rate, gave the same value to the candle.

So long as the quiet, matured candle flame burns to the same approximate shape, there being no irregularity of wick to produce smoke (denoting incomplete combustion), it would seem that a correction applied proportionally to the sperm consumption error would be sufficient as a safeguard in the use of candles, without stating the per cent. limits beyond which that error must not go.

The candle is used in this country to-day more than any other standard of light, as is shown in the summary of working standards previously given. It is probable that it will yield slowly to other standards whose variations from normal are known to be within narrower limits. It possesses the advantage over all other standards of adaptability. It is easy to keep in stock, it may be received through the mail or by express, and can be carried about in one's satchel. It has been named in many contracts, franchises and leases as the unit of light measurement—"sperm candles, 6 to the pound, burning 120 grains per hour," still continues to be used.

While there is no official manufacturer of the standard sperm candle, it is expected by the gas companies of this country that these candles shall be obtained from certain manufacturers in England, who are believed to make them as nearly as possible in exact conformity with the Notifications last issued by the Gas Referees in 1894.

The Committee recommends that when British standard candles are used as the standard and unit in photometric work on gas flames, that extra care be taken in providing against drafts, while securing good ventilation, and that the average of as many readings as possible be secured. Attention is called once again to the definition of Mr. Grafton that "the light of one English candle is the amount of light emitted and maintained for at least one hour after maturing, from the combustion of 120 grains of sperm fed by a definite sized wick in a quiet but pure atmosphere."

(B) The Edgerton Standard consists of the most luminous zone of the 3-inch flame produced by burning gas through a Sugg "D" burner with a glass chimney 1¼ inches by 7 inches. This zone is ⅛ of an inch high and is emitted through a horizontal slot cut in a brass sleeve surrounding the chimney, which sleeve cuts off all other light. Either coal gas or water gas may be used as a fuel, but variations in quality of over 2 candles may not be permitted. Greater accuracy is obtained by evenly carburetting all gas used in this standard to a constant quality and storing the fuel for use in a small holder. Its value varies from 4 to 7 candles, depending upon the richness of the gas used. This is the cheapest standard. Cost, $3.75.

Defects.—Fuel is usually not independent. Chimney requires frequent cleaning, and each new one should be re-standardized. The value varies with the quality of the gas furnished, which may be considerable from hour to hour.

(C) *Hefner Lamp.*—This is a simple, wick fed, open, spire flame, independent fuel lamp. It is small in bulk and weight. Has been thoroughly studied and all corrections may be applied by formula. For constancy and reproducibility, is the equal of the best flame standards. Burns amyl-acetate, readily procurable, costing about 75 cents per pint. Cost of certified lamp is $27.

Defects.—As a unit, very few. As a working standard, many. It requires a perfectly quiet atmosphere in which to operate; flame height difficult of attainment; flame reddish color, and only 0.88 value in candles. Has a wick.

Bodies who have adopted the amyl-acetate lamp as a standard are: First, German Society of Gas Engineers, 1894; and second, International Electro Technical Congress, 1896.

(D) *The Incandescent Electric Lamp.*—The type of electric incandescent lamp generally used for a photometric standard is of lower voltage than those in commercial use. It is spoken of as a "low voltage glow lamp." Such lamps when first burned give, for a constant voltage, an increasiug light value. After 150 or 200 hours of steady burning, this value becomes quite constant and can then be reproduced with great accuracy. In this connection, Mr. Paterson, of the British National Physical Laboratory, says: "If the only photometric standards required were of the low voltage type, the problem might be considered as solved. A properly aged, specially prepared, low voltage filament, if burnt for say 10 minutes a day for 5 days in the week, should last 2 or 3 years without changing the ½ of 1 per cent. in candle power, provided no excess voltage is applied."

It seems that after this period the lamp loses in illuminating value, due chiefly to the carbon deposit on the interior of the glass bulb. That properly seasoned lamps do remain remarkably constant is shown by comparisons made both by Dr. Sharp, of New York, and Dr. Hyde, of the Bureau of Standards at Washington. The Governmental Laboratories of America, England, France and Germany are equipped with such lamps of known value. If any change occurred after lapse of time, it is evident that an intercomparison would show it.

Dr. Hyde states: "Since obtaining the original lamps (from the Reichsanstalt) several comparisons of the standard of the Bureau with that of the Reichsanstalt have been made by means of seasoned incandescent lamps sent to Germany, each comparison indicating that the ratio of our unit to that of the Reichsanstalt has remained unchanged to within the errors of observation."

Dr. Sharp's comparison gave similar rosults.

Following are the results obtained by Lummer and Brodhun in investigating the reliability of these glow lamps as secondary standards. (See Stine, page 190.)

"Before employing the incandescent lamp as a reference light, they carefully studied its photometrical qualities. The color of the amyl-acetate flame being reddish, the color of the light of the incandescent lamp was accommodated to it by operating the lamps at a reduced voltage. Two 65-volt lamps were operated at a constant pressure of 55 volts, the electricity being supplied by a storage battery. Of the

two lamps so tested, one styled R was burned continually, while the other one, L, was operated at certain intervals. They were compared against one another at frequent intervals, being placed as the two lights on the photometer bar. The data obtained were:

Hours Burned. R.	Hours Burned. L.	Ratio L/R.
1	1	.8779
20	2	.8764
62	3	.8741
154	8.5	.8724
211	13.5	.8677

"In these tests especial accuracy was sought in the measurement of the current and potential of the lamps. Under their normal condition of burning, the light energy of the lamps varied nearly 10 times as rapidly as the electrical energy.

"The conclusion derived from these tests was that incandescent lamps under proper electrical conditions proved especially constant light sources. In addition, they possesses two excellent properties: The color of their light may be adjusted to that of the compared light, and they are portable on the photometer bar without disturbance of their illuminating power."

Defects.—As a working standard, the cost of installation of a storage battery, equipped for re-charging, with duplicate voltmeter and resistance coils, would be about $700. The battery must be charged by direct current; the lamps must be kept clean like a glass chimney; there must be several of these for the purpose of checking one against the other; care must be used that the lamp is not subjected to a voltage above its rated one; the voltmeter itself must be checked from time to time; the cost of re-charging must be considered, as well as renewal of batteries. For these reasons it is not a portable system.

It does not vary with the flame under atmospheric changes, and consequently is absolutely unfair as a standard in gas photometry.

(E) Elliott Lamp. The Elliott Standard is an oil lamp, of student lamp type, fed by wick, except that the wick and flame are flat. Constancy is obtained by excluding all but a definite sized portion of the flame by means of a flat screen, placed adjacent to the flame inside the chimney. The chimney is round and bulbous, so that the glass is relatively distant from the flame and so better preserved from fouling by it. It has an independent fuel supply, refined kerosene, and is quite constant in value over short periods of time. It is portable and cheap to operate. Costs $20. The oil costs from 15 cents to 18 cents per gallon, and a gallon will last about 48 hours steady burning. The lamp is the invention of Dr. Elliott, of New York. The tests that have been made are of an encourging nature.

Defects.—It is not strictly reproducible, but is more satisfactory in this respect than either the candle or the Edgerton Standard. Has a glass chimney which requires care for accuracy. It is difficult to trim wick to proper shapeliness of flame. Six companies using it report favorably and 4 unfavorably.

(F) The pentane 10-candle lamp is a portable though rather heavy lamp (weighing 25 pounds free, or 75 to 100 pounds boxed for shipment), having an independent volatile fuel, supplied without a wick to an Argand burner, where it burns in an open, semi-directed flame, but with no glass chimney surrounding it. The fuel pressure is maintained constant by siphon action of the heavy vapor at a constant head through a constant opening. Its atmospheric correction formulæ have been determined and for constancy and reproducibility it is equal to any flame standard. It is not so much affected by drafts as a wholly open flame. Costs $80; burns pentane costing $3 per gallon; a gallon maintaining the standard flame for a period of about 48 hours' continuous light.

It has been adopted as the standard of light by the following bodies (all English):

Engineering Standards Committee, includes (a) Institution of Civil Engineers; (b) Institution of Mechanical Engineers; (c) Institution of Naval Architects; (d) Iron and Steel Institute; (e) Institution of Electrical Engineers; National Physical Laboratory; London Gas Referees; Institute of Gas Engineers.

Defects.—Cost of fuel; difficulty of storing it; difficulty of getting it transported, and added insurance risk.

Out of 32 companies using the pentane lamp, 5 companies report them unsatisfactory.

Of each of the above standards using an independent supply of fuel, it may be said in general that about 20 minutes are required from the time of lighting until the standard is ready for use.

(G) *Jet Photometers.*—While jet photometers are used in some gas works as a criterion by which to judge of the quality of the gas made, they are not, in the true sense of the word, photometers.

The Unit.—The unit of light that has been generally adopted in this country is the British standard candle; not *a* British standard candle, but *the* British standard candle; that is, the average of all the British standard candles made under the Gas Referees' notifications.

It is stated in Appendix D that the intensity of the light from the British standard candle since the notifications were promulgated was deliberately changed by the London County Council. This introduces the possibility of the British standard candle of one decade having a different value from that of another. The unit of light should be an absolutely fixed quantity. It should be uninfluenced by atmospheric conditions, geographical location or local prejudice. The individual sperm candle is a standard and not the physical representation of the Unit. If it is used to represent exactly the intensity of the Unit, it introduces errors that cannot be gauged and that will sometimes put the manufacturer of gas of a required candle power in a false position.

While gas photometry is now about 60 years old, we have not yet adopted a scientific national unit of light. England has, and Germany has, and the English and Germans do not agree. Surely the time is ripe for the photometrists of the United States, both gas and electric, to get together on this question.

The Illuminating Engineering Society have appointed an International Committee on Nomenclature and Standards, of which our honored fellow-member of this Institute, Dr. A. C. Humphreys, is Chairman. Dr. Humphreys has appointed a sub-committee to confer with the committees appointed by the other Associations interested, for the purpose of agreeing upon a value for the National Unit of Light.

It will occur to all that the definition of any theoretical unit avails little if there can be no practical way of exactly reproducing it singly or in multiple. This difficulty has been overcome, and in the electric, low-voltage glow lamp, of exactly constant voltage, we have a custodian of the Unit that may with care be carried to any distance without change and can be maintained for an indefinite time.

Having adopted a unit of light, it would seem that the archives of the National Government would be the proper repository for it, just as it is for standard units of length and volume.

The Bureau of Standards, of the Department of Commerce and Labor, could furnish to the laboratories throughout the United States electric glow lamps, certified to as to their value in terms of the unit. Such laboratories, or the Bureau of Standards, could then give to the lamp used by the gas companies in their photometrical work their proper value when burning under normal condition in the terms of the unit.

The Committee recommends that the Institute take a lively interest in this subject of the determination of the Unit of Light. Our brother association, the English Institute of Gas Engineers, by resolution has made the unit of light equal one-tenth the value of the Harcourt 10-candle pentane lamp, at the National Physical Laboratory, and the other English Societies and Committees have followed suit.

The American Society of Electrical Engineers, Committee on Standards, have adopted the following rule on Standards:

"Section 11, Article 142: The luminous intensity of sources of light is expressed in candle power. The unit of candle power should be derived from the standard maintained at the National Bureau of Standards at Washington, D. C., which standard unit of candle power equals 100/88 of the Hefner unit under Reichsanstalt standard condition for the Hefner."

Would such a value of the unit be satisfactory to the American Gas Institute?

The International Incandescent Photometric Commission, appointed at the time of the World's Fair at Paris, met in Zurich in 1903, and formulated plans for a separate determination in England, France and Germany of the ratios existing between the Hefner, the Carcel and the Harcourt pentane lamp. At their meeting in 1907, the ratio of the intensity of the Hefner lamp to that of the Harcourt was declared to be, Harcourt pentane = 10.95 Hefners.

The English Institute of Gas Engineers and the English Engineering Standards Committee declare that the English candle equals one-tenth of the Harcourt pentane lamp, or 1.095 Hefner. The American Society of Electrical Engineers have adopted the German relation of the Hefner to the candle, in which the candle equals 1.14 Hefner. In other words, the unit of light adopted by the American Society of Electrical Engineers is 4.1 per cent. greater than the unit of light adopted by the English Institute of Gas Engineers.

It is this point that has been determined by the International Incandescent Photometric Commission when they adopted the relation between the Harcourt and the Hefner lamp.

APPENDIX "A."

PART I: THE ARRANGEMENT OF THE PHOTOMETER TO COMPARE VITIATION EFFECTS UPON STANDARDS.

In making the comparative vitiation tests between the gas flame and various standards, a V-shaped comparison photometer was used. This was constructed by attaching rigidly to the table of a regular 100-inch bar, another wing table of the same height, shown in plate V, Appendix A, at an angle of about 40° with it. Upon this wing a photometer track and 100-inch scale were mounted.

The lines joining the light centers on the 2 bars thus converged at a point; and at this point was placed a low voltage incandescent electric lamp, unaffected by atmospheric changes, which served as a standard light for both tables. It became the left hand light on one table and the right hand light on the other.

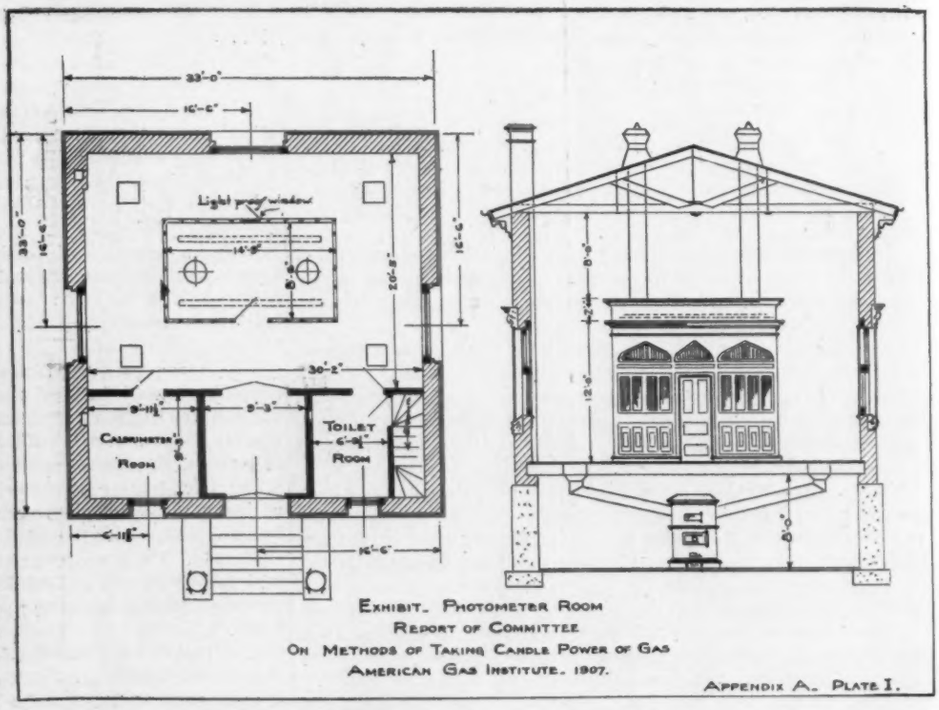
The two lights under comparison were placed in position, one on the opposite end of each bar from the above standard, and the operator standing in the angle between the tables made his disk settings alternately on the regular bar and on the wing bar.

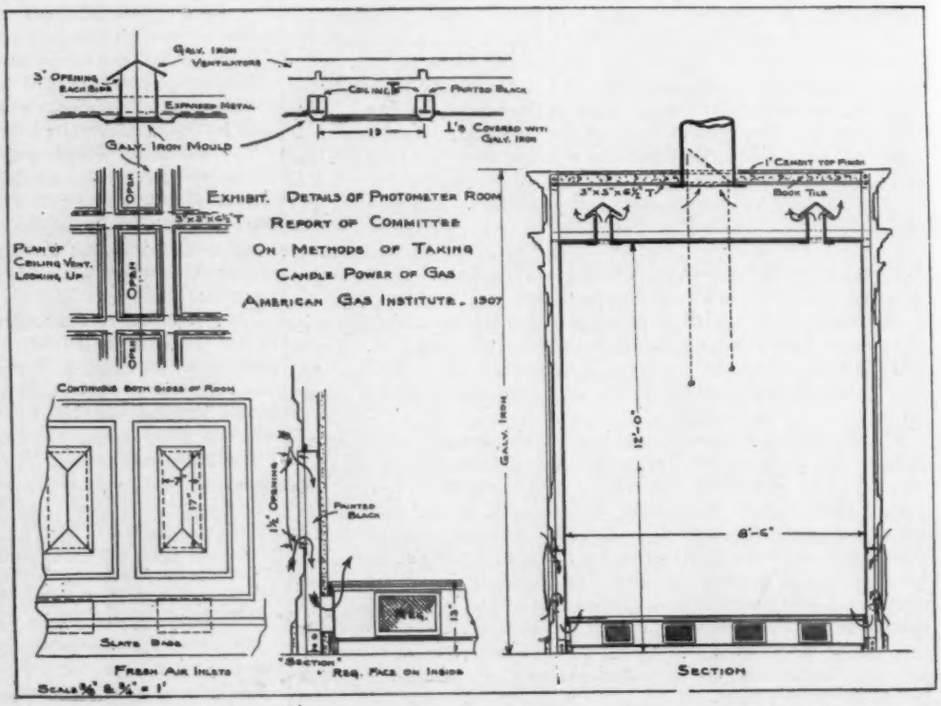
The chemist made his determination of water vapor and carbonic acid content on a table placed at a point midway between the two flames being vitiated, and there is every reason to believe that in the closed room this vitiation was equally felt by both flames.

A sketch is attached showing the V photometer. Sufficient and suitable screens were, of course, placed to exclude all reflected light.

It was impossible to present to each of the two disks that position of the filament in which it had been standardized; but so long as the light in each direction was maintained constant, our purpose to find the variations of the lights tested was effected.

In some of the tests, in order to secure a higher degree of vitiation, from 12 to 15 cubic feet of gas per hour were burned through a Fletcher type of Bunsen burner.





PART II: COMPUTATION OF THE AMOUNT OF AIR NECESSARY TO SUFFICIENTLY VENTILATE THE PHOTOMETER ROOM RECOMMENDED.

Following is the computation of the normal vitiation of air in a room when two adults, one 5-foot gas flame and one 10-candle pentane flame are present: An adult averages 20 respirations per minute, inhaling some 30 cubic inches of air each time, thus, 20 × 30 × 60 ÷ 1,728 = 21 cubic feet per hour of air exhaled. The air exhaled contains 4.3 per cent. of carbonic acid; therefore, .043 × 21 = .903 cubic feet of carbonic acid per hour.

The average of several authorities gives .71 cubic feet of carbonic acid per hour and .091 pounds of water vapor per hour as the product from one person.

By figuring the products of combustion from 5 cubic feet of illuminating gas of average quality as shown by analysis, the carbonic acid yield would be 4.4 cubic feet and the water vapor yield 5.1 cubic feet.

Assuming the use of the pentane standard, in each hour there is consumed one-sixth of a pint of liquid pentane, which vaporizes into .571 cubic feet. Upon combustion this produces 2.87 cubic feet of carbonic acid and 3.43 cubic feet of water vapor.

Hence we have as products of combustion from the two flames and the two persons per hour:

	Carbonic Acid. Cubic Fee.	Water Vapor. Cubic Feet.
Two persons	1.5	4.00
Five cubic feet of gas	4.4	5.1
0.571 cubic feet pentane vapor	2.87	3.43
	8.77	12.53

The purpose of ventilation in this case is to maintain the atmosphere in the photometer room of such purity that there will be present not more than 6 parts of carbonic acid in 10,000.

The greatest factor in the vitiation of flames is the water vapor content of the air, and it would seem that our aim in ventilation should be too keep down the excess of that. It is found, however, that a

omputation on the basis of keeping down the carbonic acid content is large enough to include the water vapor removal as well.

A total of 8.77 cubic feet of carbonic acid is produced per hour. This is equivalent to that produced

by $$\frac{8.77}{.71} = 12.3$$

persons. Kent (page 528, 1904 edition) gives 3,000 cubic feet of external air per hour per person as necessary to maintain a purity of six parts of carbonic acid to 10,000.

Hence it is necessary to provide 12 3 × 3,000 = 36,900 cubic feet of external air per hour for the room mentioned above.

APPENDIX B.

Absorptive Action of Water Upon Benzene Vapors.

An experiment was conducted to determine the absorptive action of water at different temperatures upon the benzene vapors in a gas, such action being shown by variations in the candle power.

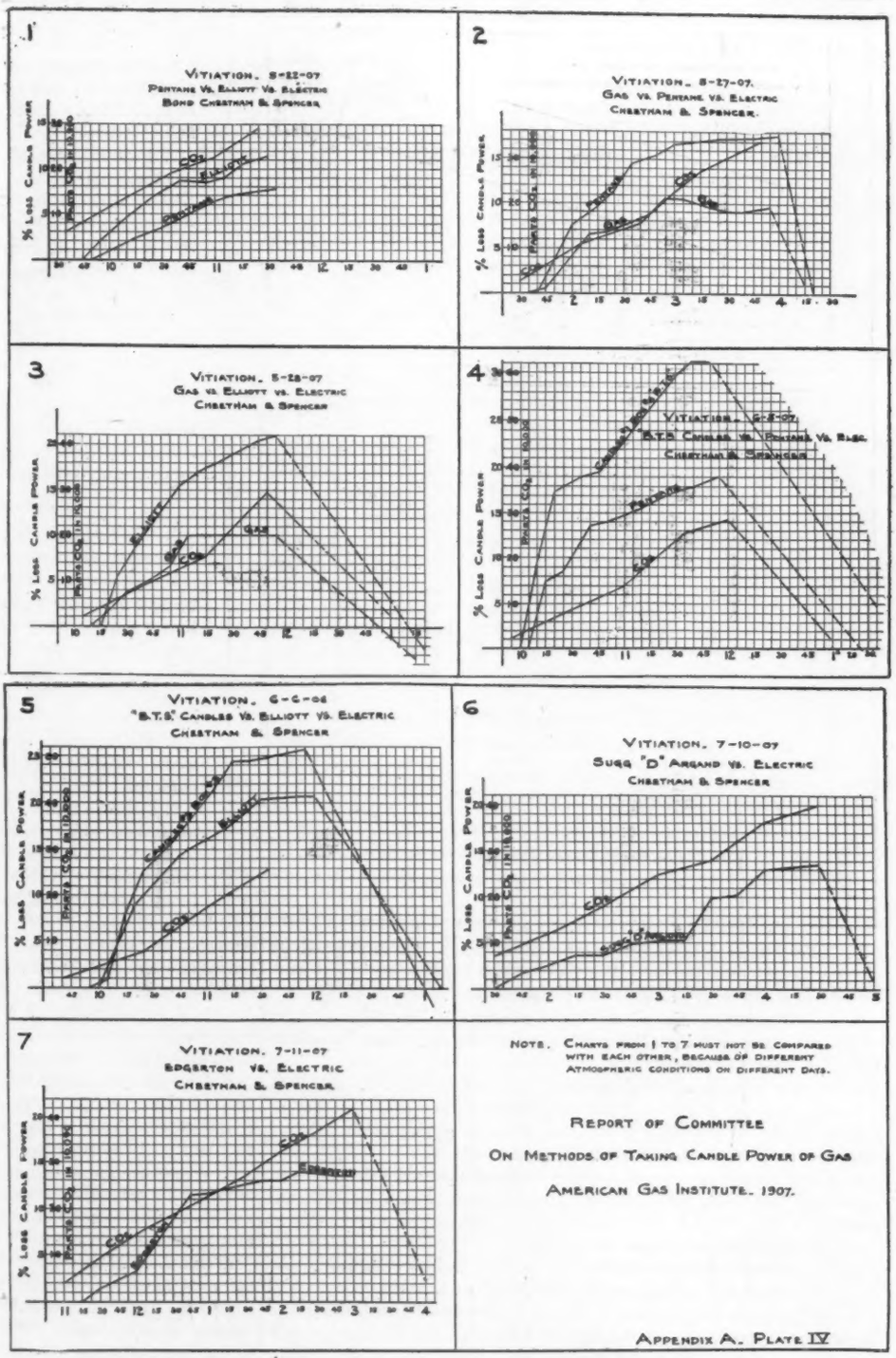
Arrangement of Apparatus.—Two correct $\frac{1}{2}$ cubic foot wet meters were used, supplied with a mixed gas from the same pipe. This gas had been subjected previously to a temperature of 35° F.

The meters were filled with gas saturated water and were placed in a water bath, the temperature of which could be controlled. The gas from meter A was led to the right end of the bar, A to R, and that from meter B to the left end of the bar, B to L. (See sketch. Appendix B, Plate 1.)

As the gas had already been subjected to a temperature of 35° F. in the distribution main, a loss in candle power in the meter and its water could not be attributed to condensation by cooling. It is due instead to the increased absorptive power for benzene vapors of the water as it was cooled.

To show this most readily, the experiment is arranged in parallel columns, the steps in the experiment being shown at the left and the results at the right under similar paragraphs.

Steps in Experiment.	*Results.*
1. Keep both meters at 70° F., and pass gas through both until candle power from each shows equal.	1. A constant relation was established between the candle powers from the two sources. $\frac{B}{A} = .9763.$
2. Gas being shut off from B., reduce its temperature to 40° F.; A continuing to pass gas at 70° F. Then compare c.p.	2. The candle power of B dropped 7 per cent. at once and took one hour to recover under these conditions.
3. Again raise temperature of B to 70° F. while its gas is shut off; A still passing gas at 70° F., then compare c. p.	3. The candle power of B at once rose to 9.5 per cent. above A, and returned to normal after 45 minutes.
4. Gas being shut off, reduce temperature of B to 55° F.; A still passing gas at 70° F., then compare c. p.	4. The candle power of B dropped at once to 4.7 per cent. below normal; recovered in 30 minutes.



Note. Charts from 1 to 7 must not be compared with each other, because of different atmospheric conditions on different days.

Report of Committee

On Methods of Taking Candle Power of Gas

American Gas Institute. 1907.

Appendix A. Plate IV

APPENDIX C.

Rules to be Observed in Taking Candle Power.

1. On beginning each day's work, make a thorough inspection of all testing apparatus to see that it is in working condition. If any part is out of adjustment, correct it before making any determination involving the use of that part, and enter such fact in the daily report.

The inspection will cover the following points (if pentane lamp is used):

a. Chimney centered, and when cool 47 mm. above burner.

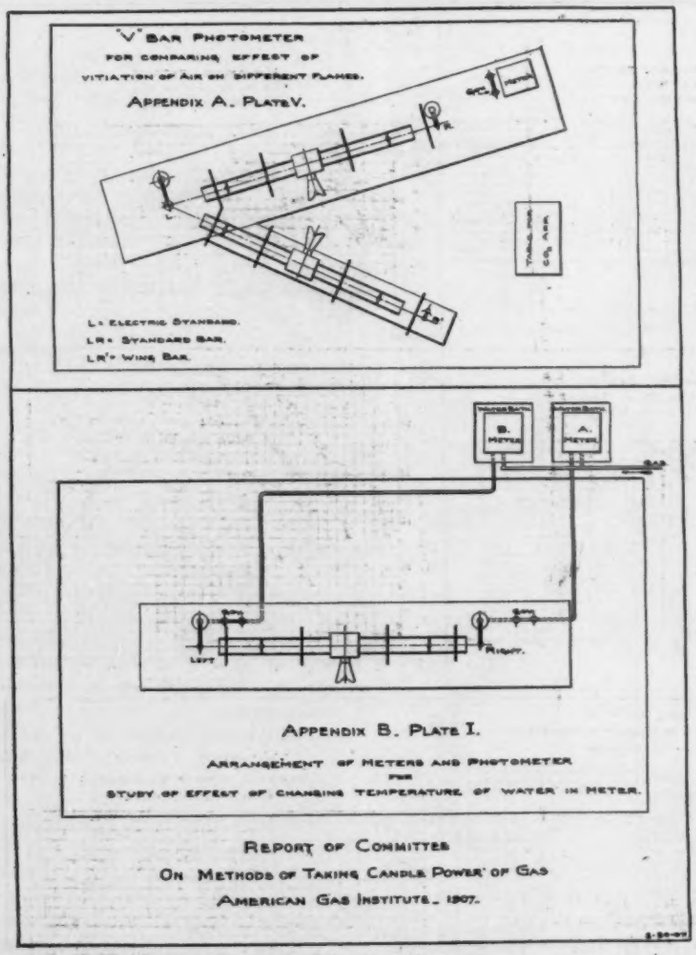
b. Lamp vertical, as shown by spirit level; bob properly hung.

c. Lamp bob on 30-inch line; exposed flame at height of disk and conical shade admitting full weight on disk.

d. Pentane showing in sight glass of saturator box.

e. Meters level; no leaks at connections.

f. Water level at proper height in gauge glass and no water left in funnel.


"V" Bar Photometer
for comparing effect of
vitiation of Air on different Flames.
Appendix A. Plate V.
L= Electric Standard.
LR= Standard Bar.
LR'= Wing Bar.
Appendix B. Plate I.
Arrangement of Meters and Photometer
for
Study of Effect of changing temperature of water in meter.
Report of Committee
On Methods of Taking Candle Power of Gas
American Gas Institute. 1907.

g. Meter hands tight and without motion when gas is stopped by placing thumb over burner pillar.

h. Disk and mirror glasses clean; disk vertical.

i. Axis of rotating disk plumb above pointer.

j. Gas flame on 30-inch line; bob properly hung; flame broadside to and at height of disk.

k. Get tip not injured or clogged and no leaks around it.

l. Meter inlet governor regulating pressure to 15-tenths.

m. Meter outlet governor in action and diaphragms pliable.

n. Center of scale plumb above center line of table.

o. Light screen so placed on bar as to prevent all reflected light reaching the disk, but excluding no part of flame being compared.

p. Clock and its equipment in order.

q. Hygrometer glasses clean and properly supplied with fluid.

r. If cooling coil is used, see that temperature is normal.

2. No readings for purposes of record shall be made until the gas to be examined shall have been purging its meter for an hour; nor if the water in the meter be fresh until it shall have been saturated with gas for 5 hours; nor until the pentane lamp has burned at normal height for 15 minutes; nor until the test burner shall have been lighted for 10 minutes.

If a portable photometer must be used and in a new location and the water in its meter has been once saturated with gas of different quality, then 3 hours must be allowed for the pipes and the meter to become saturated with the gas of new quality before its candle power is taken.

3. No reading for record shall be made during less than 2 revolutions of the meter hand within the normal rate of flow, and with 4 settings of the disk, 2 direct and 2 reversed. Readings for official purposes should be made during 5 revolutions of the meter hand and with 10 settings.

4. Quiet and silence will be preserved during the test, and after the room has been thoroughly ventilated and the door closed, sufficient time for subsidence of all drafts will be allowed before the test proceeds.

5, Pentane will be carried to the lamps in closed metal cans only. During the filling the lamps will not be lighted.

6. The temperature of the gas after its delivery into the photometrist's care for testing shall, under no circumstances, be cooled below the minimum temperature which it had reached before delivery to him.

7. Report blanks should be provided, and with ample space left for remarks. A schedule of hours for reading should be strictly adhered to.

A system to follow and an orderly habit on the part of the reader are strong guarantees of good work. To this should be added intelligence, alert to detect an unusual result and to quickly set about discovering its cause.

8. Records should be kept neatly, legibly and fully.

9. It should be the aim of every reader to thoroughly master the scientific and mechanical principles involved in the determination of correct candle power.

We will now go through the entire process (A) of standardizing an Elliott lamp versus candles, and (B) of reading the candle power of a flat gas flame against a 10-candle pentane lamp for an official determination.

(A) *Standardizing an Elliott Lamp.*

1. Thoroughly clean the chimney and select the side to be exposed to the disk.

2. Place a dry wick in the burner and turn the regulator up and down through the full length of the wick to make sure that it moves freely in its channel.

3. Place the sheet brass pattern over the head of the wick and with a pair of sharp shears trim carefully to the intended form.

Singe the head of the wick to free it from fluff and irregularities so as to obtain a smooth, even top.

4. Fill reservoir of lamp with Pratt's Astral Oil, invert it in place; fix the burner in position and set the wick flush with its channel.

5. Allow 5 minutes for the wick to fill its capillaries. In the meantime place the lamp in the position of the working standard with the wick in line between the 30-inch plumb lines and at such elevation that the center of the diaphragm will be at the height of the disk center.

6. Light the wick; place burner cap and screen with chimney mounted and side selected toward the disk. Regulate the flame for a few moments until the fuel supply is uniform, when the flame height may be fixed. The flame should have an approximately level top. It should be set not more than ¼-inch above and parallel with the upper edge of the diaphragm and when so set should present a luminous whole to the diaphragm, save the blue flame at the bottom. If it does not meet these conditions the chimney must be removed and the wick readjusted or trimmed. The tendency will be for the center of the flame to rise too high. In this case, it may be well to cut the top of the wick even a trifle concave.

7. When the flame is correctly shaped and regulated, it should so burn for 20 minutes before the test begins, and a final setting across the plumb lines should be made to see that the flame is 30 inches distant from the bar center.

8. *Candle.*—If long candles are used, one should be cut in half, its cut ends pared to a cone shape, mounted in the balance at the opposite end of the bar and lighted. These may be burning while the Elliott lamp is making ready. They should burn until the wicks project a bright red tip to the edge of the flame and there is a regular cup the full diameter of the candle, said cup being fairly dry. There must be no loose or cut strands to mar the flame's shape. The candles should then be rotated until the curvature of each wick makes an angle of 45° with the disk, and 90° with the other, one curving toward the disk and the other away from it.

9. See that the knife edges of the balance are clean and recesses free from dirt; also that edges are properly placed. See that the beam pointer does not touch the scale and that it moves freely.

10. When the candles and Elliott lamp have both arrived at the proper condition and the air in the room is pure and quiet, so adjust the candle flames that their vertical axes are 30 inches distant from the bar center, move the beam counterweight to a position near equilibrium, and make a final delicate adjustment of the counterweight by means of the screw nuts attached to it, in such a way that the beam will soon fall. As the pointer passes the zero mark on the scale, start the timer and immediately place a 40 grain weight in the

scale pan under the candles. This again raises the pointer to the top of scale.

11. Ten readings should now be made at exact intervals of one minute, beginning 15 seconds after the clock was started. Readings should be made by placing the disk near the point where its two sides are equally illuminated and then gradually decreasing the oscillations to the right and left of the proper position until the pointer stops at the point of equality. Record the reading at once. Care must be taken not to mistake differences in color of light for difference in intensity of illumination.

After five readings the disk is reversed; the candles should burn between 9½ and 10½ minutes to consume the 40 grains. After the tenth reading, watch the pointer carefully for its falling. As the pointer passes the zero mark, stop the clock and record the time elapsed. If it be exactly 10 minutes, the consumption is normal and the average reading on the bar multiplied by 2 (the number of candles) gives the value of the Elliott lamp. If the time is not 10 minutes, the correction for sperm consumption is proportional, thus:

$$\frac{\text{Observed seconds}}{600 \text{ seconds}} = \frac{\text{Observed reading}}{\text{Corrected reading}}$$

$$\text{or, corrected reading} = \frac{600 \times \text{Observed reading}}{\text{Observed seconds}}$$

EXAMPLE.—If the average of ten readings was 4.91 and the observed seconds were 584, then

$$\text{Corrected reading} = \frac{600 \times 4.91}{584} = 5.044$$

This is the value of the Elliott lamp in terms of the two candles. Multiplying by two, therefore, we obtain 10.09 candles as the value of the Elliott lamp. At least two such determinations should be made to assign the temporary daily value to the Elliott lamp.

When extinguishing the candle flames, first hold a piece of sperm against the red tips to quench them and then blow out. This avoids a disagreeable odor. Remove candle balance.

(B) *Determination of Candle Power on a Flat Flame Burner Versus the Pentane Lamp.*

1. Should the pentane lamp have been authoritatively standardized, the value so given will be used; but in case it has no value assigned, then it should be set up in the position of the working standard and its value determined in the same way as just described for the Elliott lamp, except that the value, being of a more permanent nature, should be the result of at least 30 determinations, using 6 pairs of candles in a pure atmosphere of normal humidity.

It ought not to be necessary to restandardize this lamp oftener than once per year, unless some change of parts or accident requires it.

The assigning of a value through candles, as above suggested, will rarely cause a wide departure from the 10-candle value which is normal to the lamp, but lacking certification, and there being always a possibility of a defect in the making, this check is a helpful precaution.

2. *Placing Lamp.*—The lamp, with all cocks closed, is so set in the position of the working standard, that the bob properly hung below the burner will be 30 inches from the center of the scale; and the center of the flame, when adjusted, will be at the height of the disk center and the gas flame center. The verticality of the burner and chimney is then secured by adjusting the screw legs of the tripod until the spirit level on the horizontal platform shows level in all positions of rotation. The position of the lamp should now be changed so that the burner bob is again exactly over its cross line.

When standardizing, it is well to check the accurate distance of the burner itself by turning the flame low and sighting across the plumb lines, altering the longitudinal position of the leveled lamp until the flame is visually bisected.

3. *Filling.*—Open the inlet and outlet cocks on the saturator box and the drip cock at the bottom of the vapor tube. With no flame near, pour pentane from the metal bottle into the funnel until the saturator is about two-thirds full, as seen through the sight glass. Then close all cocks.

4. Remove the conical shade to see that the inlet chimney is concentric with the other and with the burner and that the mica window is turned away from the disk. If these conditions are as just said, then loosen one chimney centering screw and insert between the chimney and the burner the 47 mm. block; then tighten the screw again until the chimney is held firmly in place and remove the block.

Replace the conical shade and so rotate it that the light port opens fair toward the disk. The lamp is now ready for lighting.

5.—*Lighting.*—The regulating cock being closed, open first the outlet cock on the saturator box; then open the drip cock. At or above 60° F., it is likely that vapor pressure will have accumulated in the saturator. The drip cock will permit its release and fill the tube with vapor ready for the siphon action upon which the supply of fuel depends; and, furthermore, discharge the excess vapor below the position of the flame.

The inlet cock is then opened to establish atmospheric pressure in the saturator and the drip cock is closed. Light a match and hold over, but not touching, the steatite burner. Gradually open the regulating cock, when the vapor will ignite gently if feeding properly.

Should there at first be an excess of air in the burner, the flame will burn with a greenish center, and as the proper proportion of the mixture is obtained, a small explosion will take place, extinguishing it. Re-light at once without changing the regulating cock, when the flame will burn normally.

Its shape at first will be truly conical, but as the hot air inner feed increases, the cone will be bulged and its top will open into a ring.

6. *Regulating.*—During the 15 minutes while the flame is maturing, or the lamp reaching a thermal equilibrium, the flame should be, from time to time, regulated to the height of the crossbar. If it be too low, it will take longer to mature; if it be too high, it will smoke the chimney. When the flame remains steady and it is time for the reading, set its height as follows: Move the disk box near to the lamp; stand in rear of the lamp, looking first in at the mica window and then past it at the reflection of the flame front in the disk glass. Lower the flame top below the chimney. When it is perfectly quiet, slowly raise it until its reflected image shows wholly luminous at the base of the chimney. This is the position of maximum intensity of the flame. A further rise of ¼ inch will not materially affect the value of the lamp. The flame top draws to 3 luminous points. If the lamp is free from drafts and the air is pure, the flame height will be approximately correct when these points are at the height of the crossbar on the American lamp. The lamp is now ready for use.

7. The precautions to be used before the testing of gas, as set forth in the above rules, having been followed, the flat flame is swung into the position of the test light, flame at right angles to the bar and 30 inches distant from its center, as shown by the correct position of the bob.

8. The meter inlet pressure, being maintained constant at 15-tenths, set the rate of flow of gas so that the time of 1 revolution of the meter hand falls between 58 and 62 seconds.

9. Both gas and pentane flame being normal and the air in the room pure, the test may now begin.

As the meter hand passes the "5" mark on the dial, start the clock. Ten readings will be taken, reversing the disk after the first 5. An interval between readings of ¼ minute will be preserved, beginning 15 seconds after the clock starts.

The clock will be stopped at the end of 5 revolutions of the meter hand. Observe the temperature of meter and the barometric pressure. We will assume the following data:

Average of 10 readings	=	2.17
Value of pentane lamp	=	9.93
Temperature of meter	=	72° F.
Barometer	=	29.65″
Rate of flow $= \frac{309}{5}$	=	61.8 secs.

Using the candle power computer, we set the temperature (72) opposite the barometric pressure (29.65) and clamp the middle scale; then 61.8 seconds opposite 9.93 (the value of the standard) and clamp the inner scale; then opposite the observed reading (2.17) we find the corrected candle power 23.2.

Should there be no computer, the formula for calculation is as follows:

$$\text{Corrected candle power} = \frac{S \times R \times V}{F \times V''}$$

, where S is the value of the standard, R is the average reading, V is the normal rate of consumption in cubic feet per hour at 60° F. and 30 inches barometer, V″ is the observed rate of consumption in cubic feet per hour at observed temperature and pressure, and where F. is the multiplication factor for correcting volume at such observed temperature and pressure to normal volume.

Our data, however, has not included the rate of consumption, but instead it has shown the observed time (T′) of passing a given quantity of gas as compared with the standard time (T) in which such quantity should have passed.

Therefore, $\frac{V}{V'} = \frac{T'}{T}$ and we may substitute this latter fraction in the foregoing equation, so that

$$\text{correct candle power} = \frac{S \times R \times T'}{F \times T} \text{ or substituting value}$$

$$\text{correct candle power } \frac{9.93 \times 2.17 \times 309}{.957 \times 300} = 23.19$$

On page 181 of the Appendix to the Proceedings of the American Gas Light Association Meeting in 1905 will be found Mr. J. B. Klumpp's "Notes on the Effects of Humidity on the Pentane Lamp."

If it is desired to know the absolute illuminating value of the above gas it will be necessary to correct the value of the pentane lamp for humidity, and it may be done in the manner there shown, in which case the new value will be used in the above formula.

For the purpose of obtaining the humidity a very satisfactory wet and dry bulb is one called the "Sling Psychrometer," used by the United States Weather Bureau. It costs about $5.

As the air in a photometer room is very quiet, and as it is necessary for the correct registration of a wet bulb thermometer that the air should flow past it, the whirling motion of the above instrument accomplishes this purpose.

[To be Continued.

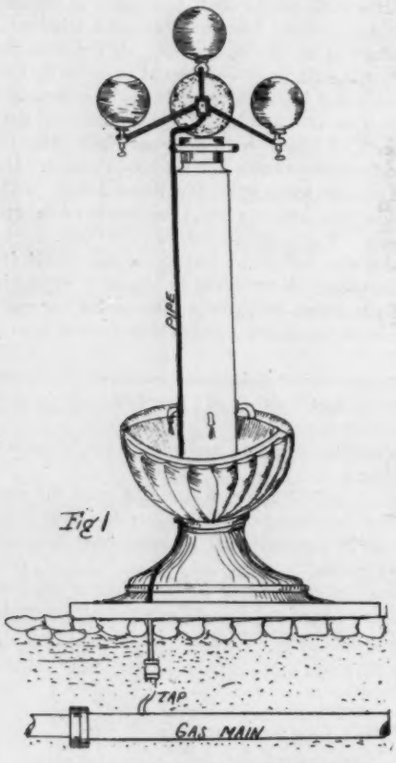


Fig 1

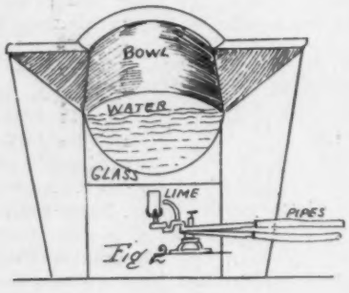


Fig 2

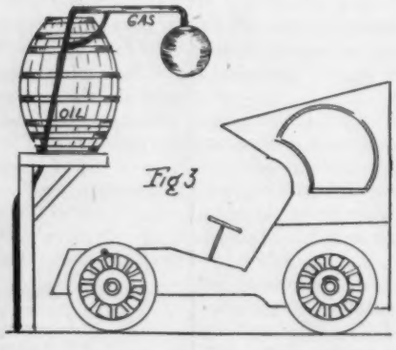


Fig 3

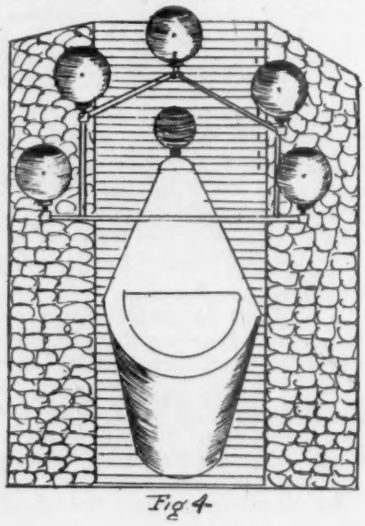


Fig 4

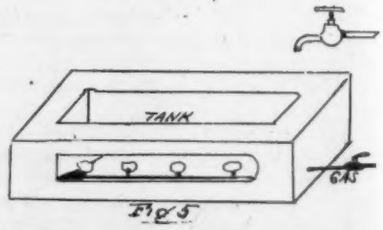


Fig 5

Lights for Drinking Fountains.

[Communicated by "ENGINEER."]

The thoughtful ones in beneficial societies and humane individuals as well, that are liberally distributing public drinking fountains throughout the country, are assisting in building up a department of the exterior lighting business which heretofore has not been very extensive. The public works departments of a great many of the larger cities and towns have also taken the matter of the lighting of drinking fountains in hand, and this move, too, has increased the demand upon lighting engineers for systems of providing illumination for watering fountains where man and beast can get water at night at the public expense.

In former times men and animals were supposed to fumble about at night and get a drink from a park or street fountain as best they could. While the plaza and street fountain could be readily used in the daytime, at night, oftentimes, when darkness prohibited the use of certain watering supplies, due to lack of systems of lighting, drinking was indeed difficult. There are thirsty people and animals at night as well as in the daytime, of course, hence the persons who are interested in furnishing the water supplies gratuitously have been calling upon gas and electric lighting engineers quite freely in recent times. The result is that practically all of the drinking fountains in up-to-date centers are arranged with lights so as to be as useful during the dark hours as when the sun's rays put darkness to flight.

Your correspondent, in speaking with superintendents of parks, streets and general public places concerning this matter, was informed that facilities for lighting drinking places, watering troughs, etc., had been and were being planned in many places.

Fig. 2 shows the plan used in some cases. The main is tapped just below, or beside, the stand with a pipe reaching from the main to the cluster of globes at the lighting point of the fountain; as a rule this lighting point is on the extreme top. In some instances the globes of light are distributed in a semicircle or complete circle about the top of the spire. Often there is but one lamp, and that is at the top; the project of having 2, 3 or more lamps with globes is the best. A cluster of 3 to 5 globes with gas jets is always pleasing to look upon from the distance. Again, I found that in some of the lighting equipments common house gas was used in ordinary jets. I noticed that a number of fountain lights were the result of burning patented combinations. Carbide gas lights are common for this purpose, the acetylene current being generated in a tank adjoining the park. The "white" lights, made by using the vapor of gasoline or kerosene on mantels, are likewise employed with varying results, but of all, the common gas arc seemed to me about the best. In fact, these gas arcs are used more extensively than the other kinds. Electrical lighting may be found also. Really the complete circle of lighting is quite thoroughly covered in the different schemes for furnishing lights for the drinking fountains in use in the parks, streets and other public places.

In new work, the pipes carrying the gases are usually incased inside the spire, for many of the spires are hollow metal and the pipe can be carried inside very readily. Cement posts are coming into favor for this service, the hollow interior being made to suit a line of pipe.

I observed, in some of the public drinking fountains, that instead of carrying the light above it was carried below. The bottom of the fountain thus lighted is made of heavy glass. Thick bottle glass is transparent, hence, if there is a strong light below, the person taking the water is able to see through the basin and water. The arrangement is made, as in Fig. 2. The thick glass bowl is adjusted in position in the stone casing of the fountain. The flowing water is the same as in the regular fountain and the drip is the same. The light is adjusted immediately below the middle of the bowl. While almost any type of strong light would do, the sample fountain that I saw was lighted with an oxy-hydrogen gas jet. The hydrogen was gen-

erated from an ether saturator, and the oxygen from a tank of prepared gas. The two gases combined in the burner, through the two pipes, and the united gases on the lime created an intensely white light. This lime light very freely and clearly lighted up the bottom of the fountain, below the glass bowl. The light striking through the water showed the clearness of the liquid, and at the same time partially lighted the vicinity. These specially lighted fountains, are, of course, for exceptional circumstances. I also notice that the automobile people have been the cause of getting up some lights, not particularly for the illuminating of water fountains, but of oil fountains, as illustrated in Fig. 3. There we see a cask of oil elevated on a platform; they have it so arranged nowadays that tickets to oil supplies can be purchased. These tickets are made with a metallic edge which just fits into a slot in the oil supply contrivance along the lonely road. Hence an autoist desiring some gasoline while on the road, applies his key and draws the necessary quantity, for which he has paid at the office. In order to have these road supply stations lighted, the lighting engineers have been called upon to install globe lights or other forms of lights after the plan shown in the cut. Ordinary gas jets are usually used. In some places gas arcs are installed.

Fig. 4 is a sketching of one man's idea of how a drinking place should be furnished with light; that is, there should be an abundance of it, so that every person when drinking water ought to be supplied with ample light, so that the liquid can be seen readily. A series of globes, arranged as in this cut, furnish an abundance of light for the purpose. Solid glass tanks, with a row of lights fixed below, are not unusual in these days. One of these glass tanks with the lights burning is shown in Fig. 5. It is simply a hollowed glass tank, with the side grooved out for the installation of the row of jets. These jets diffuse the light through the glass and the water contained in the bowl is illuminated.

The Lloyd Gas Scrubber.

On July 23d U. S. Letters Patent were granted to Mr. E. F. Lloyd, Detroit, Mich., for new and useful improvements in gas scrubbers.

Using the words of the specification, this invention relates to improvements in apparatus commonly known as gas scrubbers for removing ammonia, carbonaceous matter, sulphurous compounds, etc., from gas, and which acts through the affinity of ammonia for water.

The various valuable constituents of the gas, as well as ammonia, have a strong affinity for fresh water, and, therefore, when water is used in any great quantity, the gas is deteriorated by being robbed of these valuable elements and the resulting ammoniacal liquor is very weak, requiring an expensive distillation process to make it marketable.

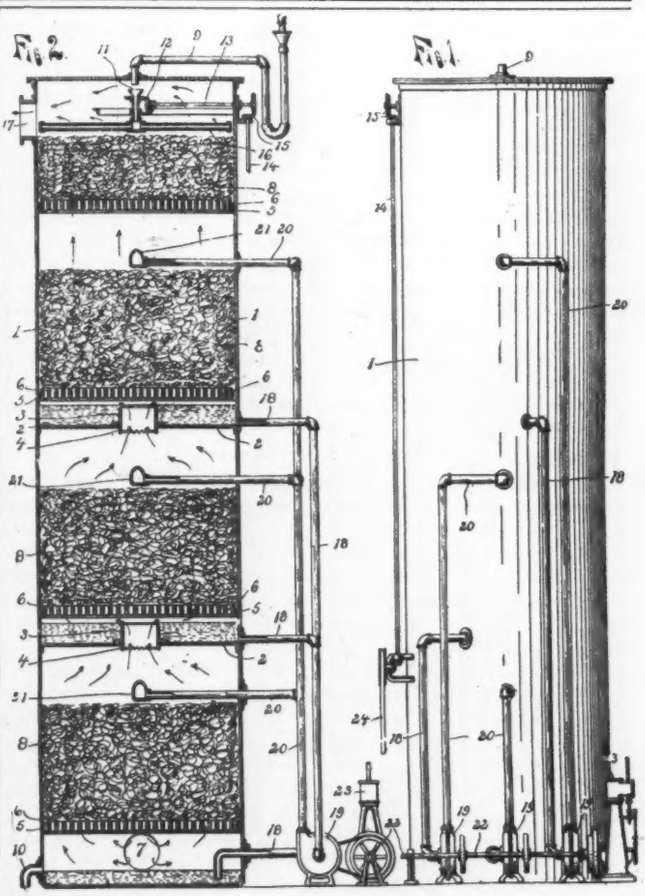
The prime object of this invention is, therefore, to effect the removal of all of the ammonia from the gas with the use of a minimum amount of water and to provide an apparatus for the purpose, the construction of which is such as to obviate the necessity of making the device of excessive height and thus expensive and inconvenient to operate and house.

A further object of the invention is to provide a simple construction which may be easily cleaned and refilled and which requires but little power to operate, the device also having the several advantages of the particular construction, arrangement and combination of parts.

Fig. 1 is a side elevation of a device embodying the invention; Fig. 2 a vertical section of the same.

As shown in the drawings 1 is a vertical cylindrical shell divided into a series of chambers by water-tight bottom partitions 2, each having an axial opening into which is fitted an overflow thimble or pipe 3, extending upward within the bottom of one chamber a short distance to maintain the ammoniacal liquor therein at the height of said thimble and projecting downward a very short distance into the top of the chamber below, said downwardly projecting edge 4 being serrated to assist in breaking up the stream of gas as it flows from the lower to the upper chamber.

Just above the upper end of each of the two thimbles is removably supported, by an angle iron ledge 5 on the outer wall, a grid 6 formed of transverse slats, and a similar grid is provided in the upper chamber near its upper end, and another in the bottom chamber just above a gas inlet opening 7 in the sidewall of said chamber. Upon each of these grids is a quantity of light, porous material 8, such as coke, excelsior or other suitable material, through which the gas may pass freely, and in passing be divided and brought into contact with the water contained in said material, which water is introduced into the upper end of the casing or column by a supply pipe 9, and, working down through the material to the bottom of the upper chamber, overflows



through the thimble in said bottom and so passes on down the column to the bottom thereof where it is carried off through a pipe 10. Upon entering, the water passes into the open, funnel-shaped end of a vertical pipe 11, supported in a suitable bearing and adapted to be revolved therein by a bevel gear 12 on said pipe in mesh with a similar gear on the end of a shaft 13, extending outward through a bearing in the sidewall of the chamber, receiving motion from a vertical shaft 14 connected thereto by bevel gears 15. On the lower end of this vertical pipe is a transverse, perforated pipe 16, into which the water passes from the vertical pipe and from which it escapes through the perforations therein as the pipe is revolved, and is distributed evenly over the surface of the scrubbing material 8 below. Opening through the side of the chamber above said material is a gas outlet 17.

In order that the scrubbing material below that which is wetted by the rotary sprinkler may be kept thoroughly saturated without the necessity of introducing large quantities of water, a draw-off pipe 18 leads from the bottom of each chamber to a suitable pump 19, and the liquor thus drawn from said bottom is forced by said pump through a pipe 20 leading into the same chamber above the scrubbing material therein and is sprayed through a nozzle 21 on said pipe at the axis of the chamber, upward in a flaring spray against the bottom of the chamber above, upon which bottom it collects in drops and falls vertically downward upon the scrubbing material. There is preferably a separate pump for each chamber, so that the liquor in each chamber will be kept separate from that in the outer chambers, it being of varying strength in the different chambers, and these pumps are all driven from a common driving shaft 22 by means of pulleys and belts, or otherwise, said shaft being driven by any suitable engine or motor 23. The vertical shaft 14 for actuating the rotary sprinkler is also driven in any suitable manner, as by a belt 24, from the engine or driving shaft.

In Figs. 3 and 4 a construction is shown in which the thimble 3 is dispensed with and an overflow flange 25 secured to the upper side of the bottom around the opening, and a rectangular perforated plate 26 is supported beneath the opening in the bottom at a distance below the same by a rectangular frame 27, formed of angle iron secured to the underside of the bottom. The liquor sprayed from the nozzle below strikes this plate and the gas in passing through the perforations therein is divided into thin streams and is brought into contact with the liquor adhering to the plate.

The ammonia laden gas enters the bottom section of the column through the inlet opening 7, and in passing upward through the grid and scrubbing material in this section is thoroughly diffused and brought into contact with the ammoniacal liquor which is constantly passing downward through said material. In passing upward it is brought to the center of the chamber in order to pass through the axial opening in the bottom, and thus passes across and through the spray issuing from the nozzle and also through the down-pouring drops falling from said bottom. In passing upward through the sections above, the gas is subjected to the same treatment, and finally passss through the thin bed of scrubbing material at the top of the column which is saturated with fresh water, and thus, by reason of the strong affinity of the ammonia for fresh water, all traces of ammonia are removed from the gas. In this construction only a small quantity of fresh water is required, and as the gas passes through the ammoniacal liquor contained in the different chambers, so many times, by the time it reaches the bottom of the column it will contain a large percentage of ammonia.

The claims of the inventor are:

1. In a gas scrubber, the combination with a casing formed with a series of chambers each having an axial opening in its bottom and means for maintaining a height of liquor in the bottom of each chamber, of a bed of scrubbing material in each chamber, a pipe leading from the bottom of each chamber, a pipe extening into each chamber above the scrubbing material therein and provided with a nozzle at the axis of the chamber, adapted to direct a spray upward and a perforated plate supported in each chamber above the nozzle at a distance below the opening in the bottom of the chamber above and having a greater area than the area of said opening.

2. The combination of a vertically extending, cylindrical casing, having a gas inlet at its lower end and a gas outlet at its upper end and divided into a series of chambers by bottom walls each having an axial opening, an overflow pipe for each of said openings, a grid in each chamber above the overflow, a bed of scrubbing material upon each of said grids, a series of pumps, a pipe leading from the bottom of each chamber to a pump, and the pipe leading from each pump into each chamber above the bed of material therein, a rotary sprinkler supported in the upper end of the upper chamber, a water supply pipe to supply water to said sprinkler, a motor, a driving shaft actuated by the motor, means for transmitting motion from said driving shaft to actuate the pump, a vertical shaft a horizontal shaft, extending into the casing and geared to the sprinkler and vertical shaft, and means for transmitting motion from the driving shaft to the vertical shaft.

Bending Device for Light Iron.

Messrs. H. Weiss & Company are putting on the market a bender to shape iron for stiffening cornices, which appeals favorably to sheet metal workers on account of its simplicity of construction, ease of operation and adaptability to the work intended. The bender makes neat, square bends at any angle desired. In Fig. 1 it is shown in its closed position, while in Fig. 2 the operator has nearly completed the bend. The illustration in Fig. 3 shows the machine open to take out

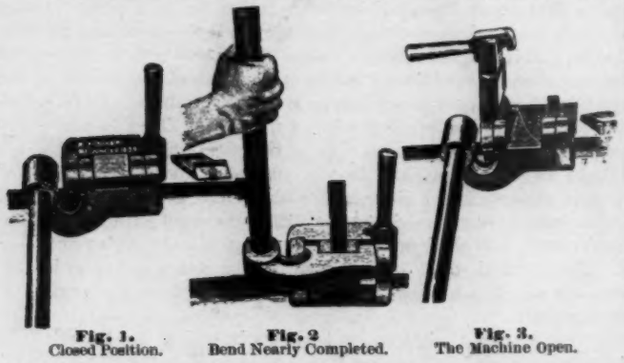


Fig. 1. Closed Position. **Fig. 2** Bend Nearly Completed. **Fig. 3.** The Machine Open.

work that has bends at each end and also in order to replace the anvil shown at the side. This has one square and one wedge shaped end. Of course, when but one bend is desired in a piece of iron the machine need not be open, and thus the operation is closely facilitated. The entire machine is made of steel, with the assembled parts easy of access, and constructed so that it can be readily screwed to a bench or table. It weighs no more than 30 pounds.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Mr. W. A. Wilson, who has acted as Superintendent of the Portage American Gas Company since 1900, has been promoted to the Superintendency of the American Company's plant at Rockford, Ills. Mr Allen Quackenbush is to take charge at Portage. Both changes become effective Junuary 1st.

Under the terms of the contract just made – it is to run for 5 years from the 1st prox.—between the authorities of Erie, Pa., and the local Gas Company, the latter agrees to perform the lighting of the streets and public buildings, in as far as that lighting is done by gas, at the rate of 5½ cents per lamp per diem.

A correspondent in Harrisburg, Pa., writing under date of the 12th inst., says: "When the Waynesboro (Pa.) Gas Light and Fuel Company was originally formed many of the residents ridiculed the idea that it could possibly sustain itself, let alone develop into a money earner, despite outward happenings and difficulties that would discourage many older and better equipped concerns. However, the carpers were wrong, as this plain statement of fact shows. The annual meeting of the Company was held the 10th inst., and the Directors choosen were: W. B. Stottlemeyer, E. Elben, C. W. Schaibley, Jno. W. Clugston, S. E. Buler, William Middlekauff and M. J. Brown. The first named succeeds Mr. Brown, whose resignation was regretfully accepted. His other important business cares had so grown as to prevent him from going on with the Company's work – he also acted as its President – which had gotten to the point to require the close services of its officers. The Company further declared a dividend of 5 per cent. out of the net earnings for the past year, and the Directors' report showed that the year was one of unusual demands upon the Company's resources, owing to a fire last summer that did much damage to the machinery. In addition to the expenditure on damage account extra expense was entailed by the putting down of several important stretches of distributing mains, but in return for all this the manufacturing and distributing plants are in better condition than ever. The use of gas for cooking and intermittent heating is now an important factor in its send out, and the sale on such accounts is being intelligently directed by the Company. I would be remiss indeed did I fail to note that in Superintendent John N. Stickell the owners of the Company have a man whose capability has been well tried by them many a time.—J. V. M."

Mr. Andrew Hauser has resigned the Superintendency of the Beaumont (Tex.) Gas Company in order to engage in business on his own account in that city. His successor is Mr. M. T. Walker, of Wausau, Wis.

"L. M. G.," writing under date of the 11th inst., says: "Dear Journal: I thought your readers might like to know, especially those connected with Companies having good bowling teams, that the Milwaukee Gas Company's picked bowling team would not turn down any challenge for a match game with any comparatively nearby Company's team. Mr. Bryce McAdam can be communicated with in this matter."

There is little doubt that the towns of Whitman, Rockland and Abington, Mass., will soon have their demands for a gas supply attended to. And the one who is likely to lead them out of the wilderness of non-gas supply is Mr. P. J. Nevins, the wideawake Manager of the Haverhill Gas Company.

Mr. James C. Ernst, of Covington, Ky., has been elected Vice-President of the Columbia Gas and Electric Company.

Mr. C. W. Hunter has secured control of the Ocala (Fla.) Heat and Gas Company, and will hereafter act as Manager thereof.

Mr. Clare D. Beverstock has resigned from the service of the Keene (N. H.) Gas Company to assume charge as Superintendent of the Greenfield (Mass.) Gas Light Company, succeeding Mr. George H. Priest. The latter, after a short vacation, will engage in business in Covington, Ky.

Mr. F. R. Hutchinson, owing to the retrenchment policy now underway in the Public Service Corporation, of New Jersey, retires from its service the 1st prox. He has been appointed Eastern Representative of the Dangler Division of the American Stove Company, and his territory comprises New Jersey, Eastern Pennsylvania, Delaware and Maryland. Mr. Hutchinson originally started in with the

Peoples Gas Improvement Company, of Trenton, N. J., under the tutelage of Mr. Frank D. Moses, and remained in Trenton during the amalgamations and changes which resulted in the formation of the Public Service Corporation. Since 1904 he acted as Assistant Commercial Agent, Gas Department, Southern Division, of the Corporation, and he leaves its service with a long record of work done worthily and well.

WE are indebted to a correspondent in Greenfield, Mass., for the following particulars respecting the "opening" of the local Gas Company's office: "Showing the largest and most varied stock of gas appliances and utensils to be found in almost any New England city outside Boston, the Greenfield Gas Light Company opened its new office and salesroom in the Kennedy block, the evening of the 9th inst. The Company announced that it would exhibit every conceivable gas fixture, and it fulfilled its promise, for everything, from the toy engine up to the latest type of combination baking, broiling, roasting—and a few other things—kitchen range, was there. Demonstrators were on hand to explain the usefulness of the appliances, music by Allen's orchestra delighted the ear of the visitor and refreshments were to be had in the form of toast, made on the Company's rapid-fire toaster and served by A. J. Meyer, the firm's Business Solicitor, whose accomplishments as a *chef* are only exceeded by his ability to convince you that gas is indispensable to home comfort. Handsomely finished in light oak, the transformed store impresses one as the best appointed in Greenfield. On the east side is installed a massive triple fireplace, above whose heavy mantel is a large showcase devoted to the display of portable lamp globes of every color and kind. The fireplaces, tiled throughout, are equipped with the latest type of gas logs, and fireplace sets. The center of the store is given up to showcases, filled with every kind and sort of lighting appliances, even to the electric bullseye, while hanging from the ceilings are all kinds of house fixtures, polished and brushed brass and wrought iron. Disproving the claim that gas illumination is inconvenient owing to the necessity for the use of matches, several chandeliers are shown with button attachments which accomplish lighting and extinguishing without trouble. Perhaps, in fact certainly, this closing matter is not pertinent to the story, but just to finish the narrative up furtively. The ending is this: 'In the nature of a good omen for the opening of the new quarters was the arrival, a couple of days before, of a much begrimed white kitten who wandered in and made herself at home after finding a soft corner under the Manager's desk. The wanderer was immediately adopted under the name of Mascot, and she is now a treasured possession of the office. Transformed by a bath into a snow white ball of fur, Mascot proudly wears a silver mounted collar on which the Company's name is engraved. She passed Monday evening comfortably, sharing a basket with a bull dog, the possession of Colonel Rossman, of Keene, N. H., President of the Company.'"

THIS explains itself, the utterances having been made some days ago by Mr. John I. Beggs: "The election of Mr. W. V. N. Yowelson to the Presidency of the Union Electric Light and Power Company as my successor, does not signify that I shall retire from the Presidency of the United Railways and Laclede Gas Light Companies. I resigned the Presidency of the Union Electric to devote more time to the United Railways and Laclede Gas. As to the recent action of the North American Company, the Board merely decided not to declare a dividend now. The regular United Railways and Laclede Gas dividends will be paid. We shall carry on absolutely no new work until conditions change and confidence is restored."

THE new issue of shares of the Consumers Gas Company, of Toronto, Canada, was sold at auction about a fortnight ago. The output amounted to 9,000 shares, of the par value of $10. The bidding was spirited and the surprising average of 18½ was realized—on the par of $100, of course the rate was 180½. Very few concerns in Canada could realize such prices for auctioned shares in these days of tight money markets. The largest buyers were those connected with the Company, the list including the Messrs. Blaikie and Messrs. Pearson (Senior and Junior), Gooderham and Johnston.

WOULD it not be a wonderful thing if out of the ashes of the old Bay State Gas Company something of worth should spring. In any event the attempt is to be made, although it would look more promising were any other man than Mr. Thomas W. Lawson named as the President of the rejunevated Company. At any rate he has been elected its President, with ex-United States Senator J. Frank Allen as his understudy.

THE Louisville (Ky.) *Post* is authority for the following variegated narrative: "All the colors of the rainbow will soon be seen on the poles of the various corporations which have poles standing on the streets in New Albany, Ind. Following the order to the Louisville and Southern Indiana Traction Company to paint its poles, the New Albany Board of Works ordered the Home and Cumberland Telephone Companies, the Postal Union and Western Union Telegraph Companies, the United Gas and Electric Company and all other corporations to paint their poles. Each is to select a different color so that they will be distinguishable. The Traction Company has selected bright red for its poles, and has begun painting them. The other Companies have not announced what colors they will select."

THE Gas Bench Construction Company, of St. Louis, Mo., has recently been awarded contracts for benchwork at Freeport, Ills., Pluma, So. Dak., Emporia, Kas., Kewanee, Ills., Portage, Wis., and Delray and Adrian, Mich. The Company further reports an excellent outlook, if anything like numerous inquiries can be accepted as an indication in such respect.

THE Portsmouth (N. H.) Gas Company is arranging for piping across the Piscataqua river which will enable it to distribute its product in the growing village of Kittery, Me.

THE United Gas Improvement Company's regular quarterly dividend of 2 per cent. is payable the 15th prox.

A CORRESPONDENT in Wilkes-Barre, Pa., forwards the following under date of the 15th inst.: "Out of the ashes of the old organization the Kennett (Pa.) Gas Company has been formed, a new corporation with a capital stock of $75,000, and plant and mines worth $40,000 or thereabouts. The Chester County Light and Fuel Company, doing business at Avondale and Kennett Square, and having its property and franchises sold by the bondholders and its mortgage purchased by ex-Burgess C. Wesley Talbot, of West Chester, has been reorganized and is now known as the Kennett Gas Company. The Board of Directors of the new Company consists of these gentlemen: D. Duer Phillips, Cashier of the National Bank of Kennett Square; Harry T. Hurford, of that borough; John E. Huey, Walter S. Talbot, Esq., and C. W. Talbot, Esq., of West Chester. The Company is busily engaged in introducing gas into the houses of Kennett Square, and in a short time will begin to lay a main to West Grove."

CONSTRUCTION work on the proposed municipal gas plant for Paulsboro, N. J., delay over which was occasioned by the financial upheaval of the last 6 months, is to be commenced at once, at least Mayor Adamson of that place has so publicly declared.

THE Chicago *American* has been "assisting" to the howling degree in the movement for "reproving" gas meters in that city. The process is actually underway, and here are the results of one day's testing—it is the only example that we have of any one day's work in this regard: Total meters tested, 16; correct (that is, within 2 per cent. either way), 12; fast, 1 six per cent., 1 four per cent., 1 five per cent.; slow, 1 twenty-three per cent. The slow meter was shown to be passing more gas per month than any two of the other 3 fast ones.

A NEW holder will be erected this year at Chattanooga, Tenn. The general scheme of reconstruction at the named point, which was planned for last fall, at an estimated expenditure of $200,000, will be delayed until the spring of 1908.

"J. B. M.," writing from Washington, D. C., under date of the 12th inst., incloses the following: "Last week Justice Gould, in Equity Court, No. 2, denied the petition of the District Commissioners for the dismissal of the application of the Washington Gas Light Company for the ascertainment by the Court of the cash value of its plant. At the request of Corporation Counsel Thomas the Court allowed him certain time in which to file the formal answer of the Commissioners to the application. In refusing to dismiss the application, Justice Gould said he saw nothing unconstitutional or incongruous in the act of June 6, 1896. He was of the opinion, he said, that it is fitting that such power should be intrusted to the courts, and he knew of no other body to which such power may more properly be delegated. Counsel for the Gas Company referred to the fact that in the past Congress had frequently authorized the judiciary to ascertain the cost of extension and additional stock to be issued by railroad companies, and referred to the Seibold case, in 100 United States, 381, where Congress had vested in the Circuit Court the power of supervision of elections. They declared Congress had the right to ask the Court to conduct the present proceedings, and there was nothing unconstitutional in the delegation of such power to the judiciary. Judge Gould granted leave to Attorney John B. Daish, as 'friend of the Court,' to file a brief in favor of the dismissal of the application."

THE Albion (Mich.) Gas Light Company has increased its capital stock to $150,000 from $100,000.

THE AMERICAN GAS LIGHT JOURNAL

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PROPRIETORS.

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NOTIFICATION RESPECTING ADVERTISING.

Orders for new advertising, or for changes in standing advertisements, to insure attention in the issue following their reception, must be in hand any time of Wednesday.

AGENTS:

New York—American News Co., 39 and 41 Chambers St.
Germany—Lemcke & Buechner, of New York.
England—Aug. Siegle, 30 Lime Street, London.

MONDAY, DECEMBER 23, 1907.

The Market for Gas Securities.

The lethargic not to say dropsical condition shown by Consolidated during the past fortnight was dissipated this morning by an 8-point rise in the bid price. The shares closed last night (Thursday) at 90 bid, offered at 91. The first sale to-day (Friday) was at 95 and at 1 P.M. it sold at 99. Apart from its actual value we are not cognizant of any special cause that should put it up just now in 10-point leaps. It is worth at this time of writing at least 150, if it is worth anything. The trading to-day was very active.

Brooklyn Union remains absolutely lifeless. Massachusetts Gas Companies, of Boston, is again on the upward move, and so is Peoples, of Chicago, which will likely show a decided spurt before long. The general situation is in favor of decidedly higher prices.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.
16 WALL STREET, NEW YORK CITY.

DECEMBER 23.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share:

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,400	100	90¼	90
Central Union Gas Co.—				
1st 5's, due 1972, J. & J	3,000,000	1,000	92	97
Equitable Gas Light Co.—				
Con. 5's, due 1932, M. & S.	1,000,000	1,000	—	105
Mutual	2,500,000	100	—	170
New Amsterdam Gas Co.—				
1st Con. 5's, due 1948, J. & J.	11,000,000	1,000	80	85
New York & Richmond Gas Co. (Staten Island)	1,500,000	100	37	43
1st Mtg. Gold Bds. 5 p. ct.	1,000,000	—	98	104
Northern Union—				
1st 5's, due 1927, J. & J	1,250,000	1,000	90	98
New York and East River—				
1st 5's, due 1944, J. & J	3,500,000	1,000	100	105
Con. 5's, due 1945, J. & J	1,500,000	—	97	101
Standard	5,000,000	100	70	100
Preferred	5,000,000	100	100	125
1st Mtg. 5's, due 1930, M. & N.	1,500,000	1,000	100	105
The Brooklyn Union	15,000,000	1,000	80	90
1st Con. 5's, due 1948, M. & N.	15,000,000	—	91½	92
Yonkers	299,650	500	130	—
Out-of-Town Companies.				
Bay State	50,000,000	50	¼	⅝
" Income Bonds	2,000,000	1,000	—	75
Binghampton Gas Works	450,000	100	—	65
" 1st Mtg. 5's	500,000	1,000	95	100
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	5	8
" " Bonds, 5's	5,250,000	1,000	63	66
Capital, Sacramento	500,000	50	—	35
Bonds (6's)	150,000	1,000	—	—
Chicago Gas Co. Guaranteed Gold Bonds	7,000,000	1,000	104	103¾
Cincinnati Gas and Electric Co.	20,500,000	100	92½	93
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	92	98
Columbus (O.) Gas Lt. & Heating Co.	1,082,750	100	87	88
Preferred	3,028,500	100	107½	108
Consumers, Toronto	2,000,000	50	200	204
Consolidated, Baltimore	11,000,000	100	—	90
Mortgages, 6's	3,000,000	—	—	118
Chesapeake, 1st 6's	1,000,000	—	—	—
Equitable, 1st 6's	910,000	—	—	—
Consolidated, 1st 5's	1,490,000	—	—	112
Consolidated Gas Co. of N. J.	1,000,000	100	15	17
Con. Mtg. 5's	880,000	1,000	92	95
Bonds	75,000	—	—	100
Detroit City Gas Co.	6,000,000	50	—	50
" Prior Lien 5's	4,618,000	1,000	—	98
Detroit Gas Co., 5's	381,000	1,000	75	80
" Inc. 5's	16,000	100	98½	100
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	—	101
Essex and Hudson Gas Co.	6,500,000	—	39	40
Fort Wayne	2,000,000	—	—	—
" Bonds	2,000,000	—	55	—
Grand Capids Gas Lt. Co., 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	190	200
Hudson County Gas Co., of New Jersey	10,000,000	—	100	105
" Bonds, 5's	10,000,000	—	101	103½
Indianapolis	2,000,000	—	60	70
" Bonds, 5's	2,600,000	—	104½	105
Jackson Gas Co.	900,000	10	82	—
" 1st Mtg. 5's	220,000	1,000	97	100
Kansas Cits Gas Light Co., of Missouri	5,000,000	100	—	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	97	97⅛
Preferred	2,000,000	100	92¾	93
Bonds	10,000,000	1,000	104	104⅛
Lafayette Gas Co., Ind.	1,000,000	100	—	60
Bonds	1,000,000	1,000	60	65
Louisville	2,470,000	50	143	145
Madison Gas & Elec. Co.				
" 1st Mtg. 6's	300,000	1,000	106	106¾
" 6 per cent. scrip, due 1910	100,000	25	60	60½
Massachusetts Gas Companies, of Boston	25,000,000	100	43	48¼
Preferred	25,000,000	100	77	77¼
Montreal, Canda	9,000,000	100	218	218¾
Nashville Gas Lt. Co.	1,000,000	100	110	—
Newark, N. J., Con. Gas Co.	6,000,000	—	86	88
Bonds, 6's	6,000,000	—	137	138
New Haven	2,000,000	25	200	—
Peoples G. Lt. & Coke Co., Chicago	25,000,000	100	78¼	78¾
1st Mortgage	20,100,000	1,000	—	—
2d "	2,500,000	1,000	104	—
Rochester Gas & Elec. Co.	2,150,000	50	88	—
Preferred	2,150,000	50	118	—
Consolidated 5's	2,000,000	—	104½	105½
San Francisco, Cal.	15,500,000	—	—	—
St. Joseph Gas Co.—				
1st Mtg. 5's	751,000	1,000	92	—
St. Paul Gas Light Co.	1,500,000	100	45	47
1st Mortgages, 6's	820,000	1,000	113	114
Extension, 6's	600,000	1,000	112½	115
General Mortgage, 5's	2,445,000	1,000	90¾	—
Syracuse, N. Y.	1,978,000	100	50	55
Bonds	2,047,000	1,000	103	—
Washington, D. C.	2,500,000	20	345	346
1st Mortgage, 6's	600,000	—	—	—
Western, Milwaukee	4,000,000	—	—	—
Wilmington, Del.	600,000	50	230	—

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DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO., N. W. CORNER BROAD AND ARCH STS., PHILADELPHIA, PA., Dec. 11, 1907.

The Directors have this day declared a quarterly dividend of 2 per cent. (one dollar per share), payable Jan. 15th, 1908, to stockholders of record at the close of business, Dec. 31, 1907. Checks will be mailed.

1697-5 LEWIS LILLIE, Treasurer.

Estimates furnished for the erection of complete gas works or the extension and modernizing of old works. All work warranted. Both water gas and coal gas.

EMPIRE GAS IMPROVEMENT & CONSTRUCTION COMPANY,
1686-tf 49 Wall Street, New York.

Position Wanted.

A successful and competent young gas man would like to communicate with some gas company likely to need a gas manager in the near future. Is thoroughly up to date on all new business methods and distribution systems, and both coal and water gas manufacture. Will be open for a position between December 15, 1907 and January 1, 1908. Can show a very good record. Address, "D. K.,"
1698-8 Care this Journal.

Position Wanted.

By a young man possessing good references as to character and ability, the management of a gas company's interests and affairs in a town of 10,000 or more. Company just starting and needing services of a careful manager, particularly. Any and all interested address at once, "W. M.,"
1695-5 Care this Journal.

Position Wanted

As Manager of Gas, Electric, or Combined Property.

Twelve years' successful experience as manager and engineer. Best of reference. Can invest small amount in property. In city of not less than 25,000. Address, "A. D.,"
1695-4 Care this Journal.

Position Wanted

As Superintendent of Gas Company,

By young man of 7 years' practical experience in the manufacture and distribution of both coal and water gas. Desires position as superintendent in city of 10,000 to 25,000 population. Best of references.
1697-2 Address, "S. W.," care this Journal.

WANTED,

Position as Superintendent or Manager,

By one who has had wide practical experience and has met with success in above capacity. Can furnish excellent references. Address, "J. O.,"
1697 tf Care this Journal.

POSITION WANTED

As Manager or Superintendent of Gas Company.

Am well versed in both the construction and operation of coal and water gas works. Can give the best of references.
Address, "D. E. C.,"
1697-2 Care this Journal.

Position Wanted.

Man of 30, married, gradnate Massachusetts Institute of Technology course of chemical engineering, with 10 years' experience in all branches of manufacture and distribution of coal and water gas under high and low pressure, will be open for position Feb. 1, 1908. Record as manager of last company, 61 per cent. increase of business in first 2 years. Best of references on application to "P. H. G.,"
1696-2oot Care this Journal.

Position Wanted.

Young married man, 30, having held various executive positions, covering all departments of gas business, works, distribution and office, during the past 7 years, and now superintendent of a company in the Eastern States, desires to change position between now and spring of 1908. Good reasons for making change. Best references as to character and ability. No objection to going to any part of the United States or abroad. Address, "C. P. N.,"
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A POSITION AS GAS MAKER.

A young married man, with 10 years' practical experience in water gas making, would like to make a change. Have good reasons for changing. Can run 1 or 2 machines and can furnish any references that may be required.
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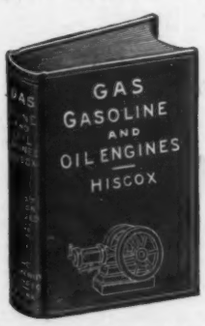

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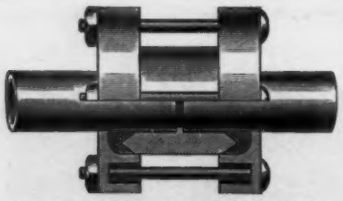

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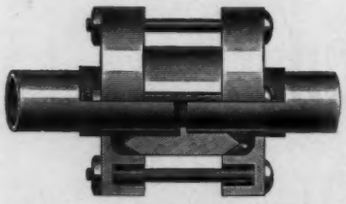

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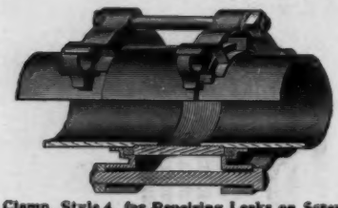

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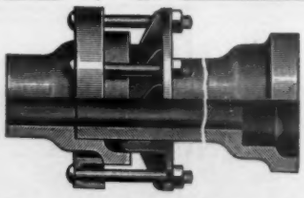

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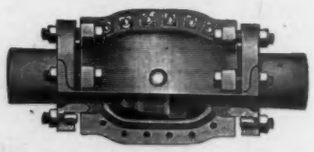

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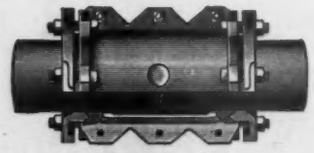

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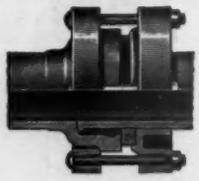

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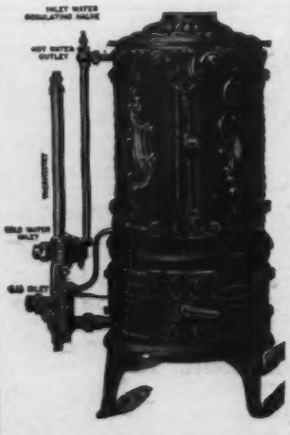

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SOME EXCLUSIVE FEATURES.

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Bray's Union-Jet.

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Take up most any publication devoted to Gas, read any book which deals with Gas, or look over the papers as read before the various Associations, and you will find that **BRAY BURNERS** are always mentioned as the standard. The leading experts recognize and always quote them as such.

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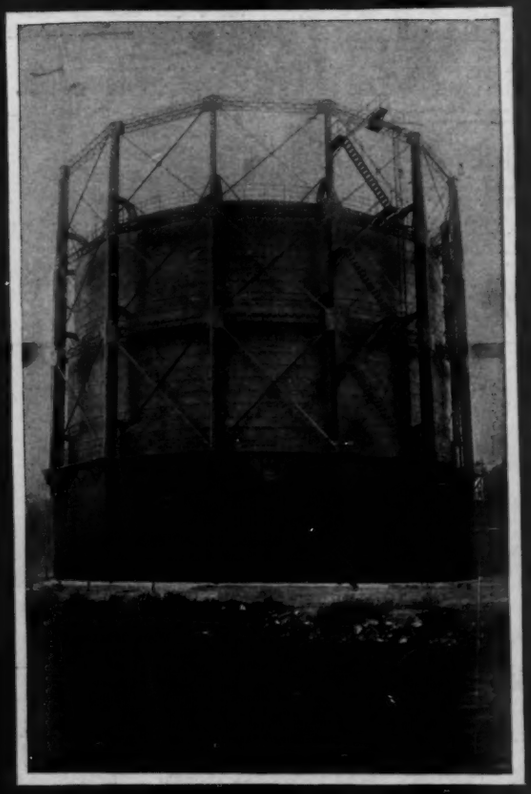

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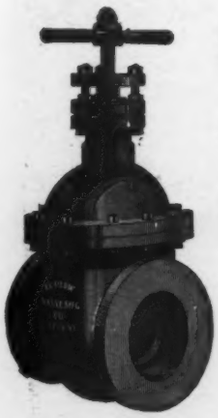

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For every 1,000 cu. ft. of water gas 40 to 48 lbs. of anthracite are consumed in the generator, while 24 lbs. should theoretically be enough. The 40 per cent. to 50 per cent. excess is the margin of possible saving. By passing the hot, waste, stack-valve gases through a GREEN AIR HEATER you can cut down the bill for generator coal by at least 10 per cent. The air forced to the generator is passed through the tubes of the Air Heater and absorbs the waste heat from the stack-valve gases and returns it to the generator. The higher temperature in the generator, carburetter and superheater results, also, in a saving of oil, amounting to about one-fifth gallon per 1,000 cu. ft. of gas.

After the stack-valve gases have passed through the Green Air Heater they may be then passed through a GREEN FUEL ECONOMIZER to heat the boiler feed water, saving as much as 25 per cent. of the boiler fuel. The result is that a Green Air Heater and a Green Fuel Economizer will save from 50 per cent. to 60 per cent. of their first cost annually in a water gas plant. Write for circular "AG" and results of actual tests.

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Used the World Over.

Necessary Equipment

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12-Inch High Pressure Governor.

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We make all sizes for all classes of reduction,

DOUBLE and SINGLE DISTRICT STATIONS,

And Individual Service Governors for Reducing High Pressure.

HOLDER GOVERNORS

And Low Pressure Regulators, all of the Dry Diaphragm type.

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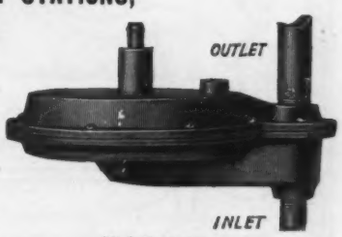

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THE LLOYD INTENSIVE SCRUBBER.

DETROIT—MICHIGAN

"A Stationary Rotary."

Sold under Positive Guarantee of Efficiency, Durability and Economy.

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WE hope that at this glad Christmas time you may forget your cares, your business, your enemies, your doubts and sorrows, and feel in spirit and in fact that gentle influence of the day which awakens in the hearts of the people of all civilized nations, 'PEACE ON EARTH, GOOD WILL TOWARD MEN."

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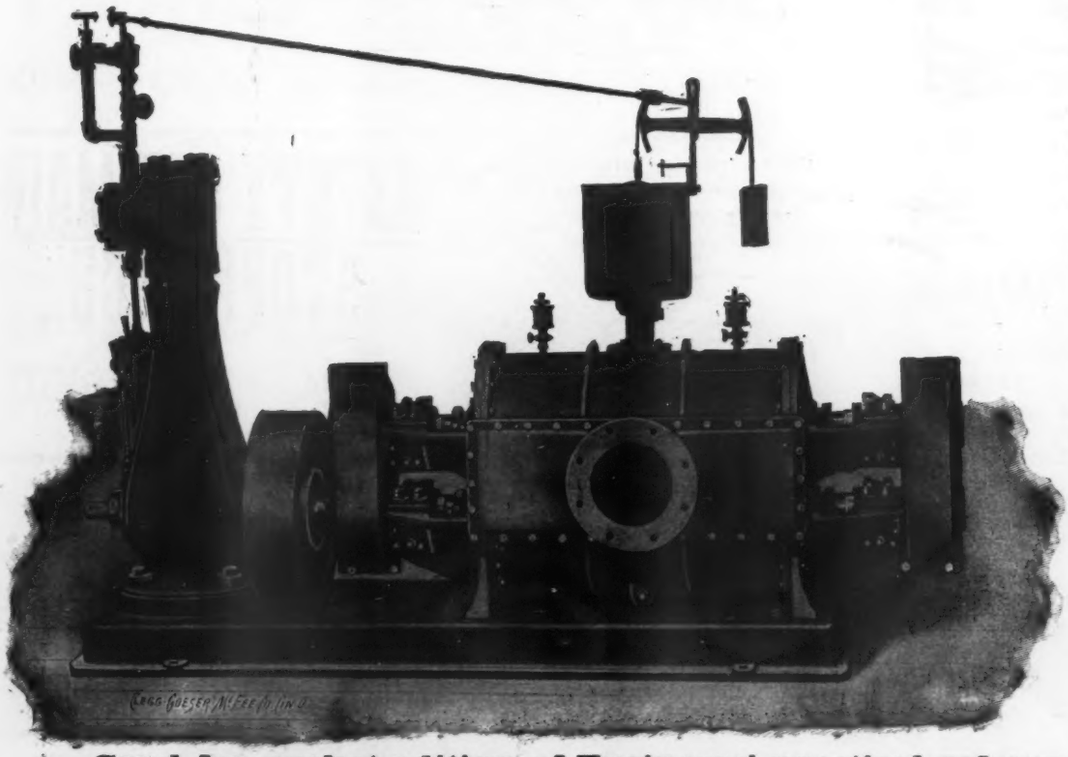

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Most perfect and sensitive Governor.

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Send for pocket edition of Engineers' practical reference book.

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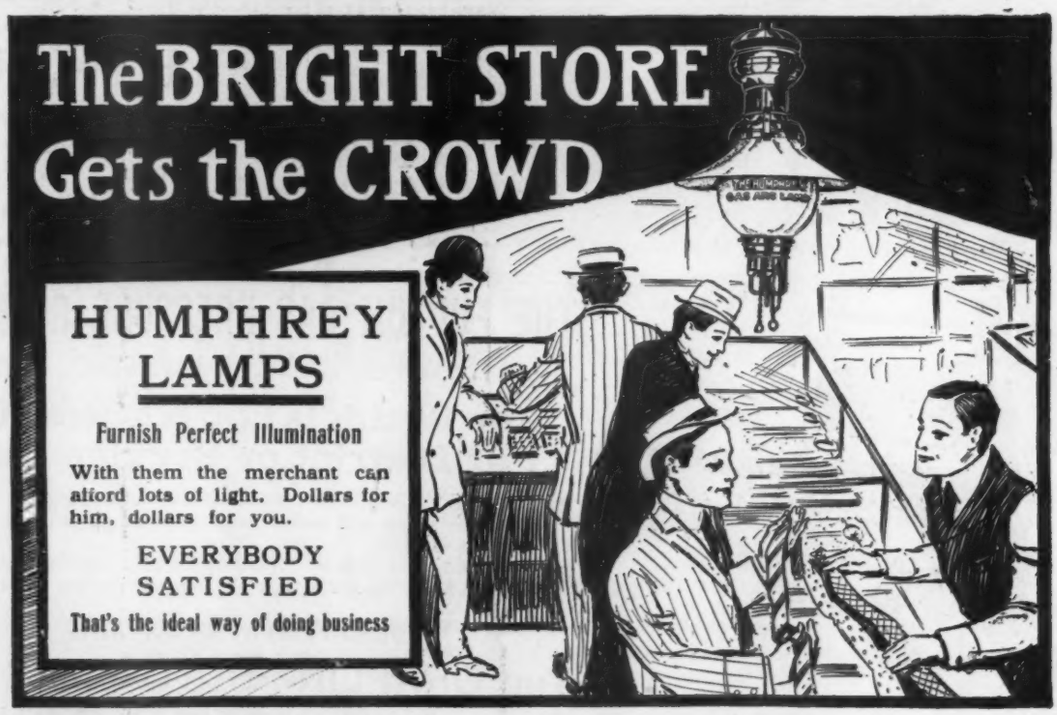

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Furnish Perfect Illumination

With them the merchant can afford lots of light. Dollars for him, dollars for you.

EVERYBODY SATISFIED

That's the ideal way of doing business

GENERAL GAS LIGHT CO.,

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WE hope that at this glad Christmas time you may forget your cares, your business, your enemies, your doubts and sorrows, and feel in spirit and in fact that gentle influence of the day which awakens in the hearts of the people of all civilized nations, 'PEACE ON EARTH, GOOD WILL TOWARD MEN."

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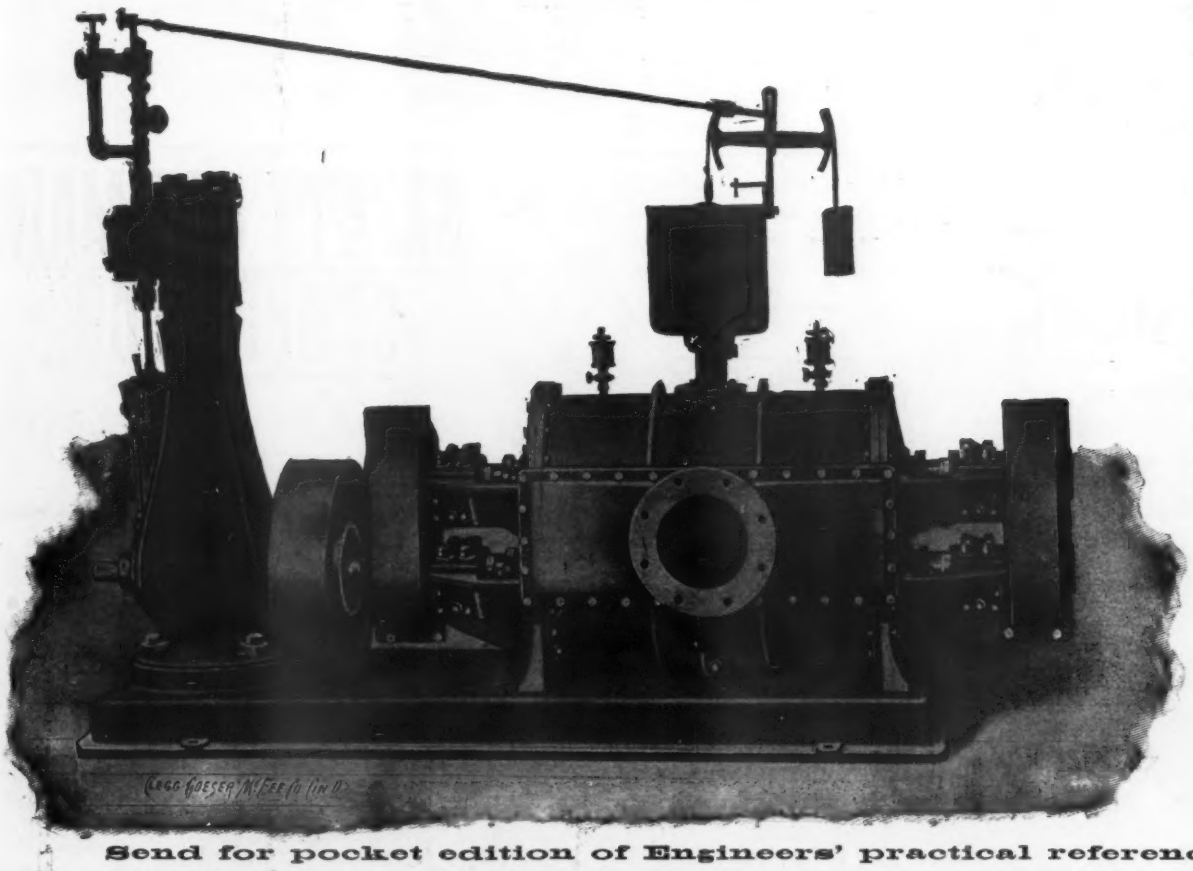

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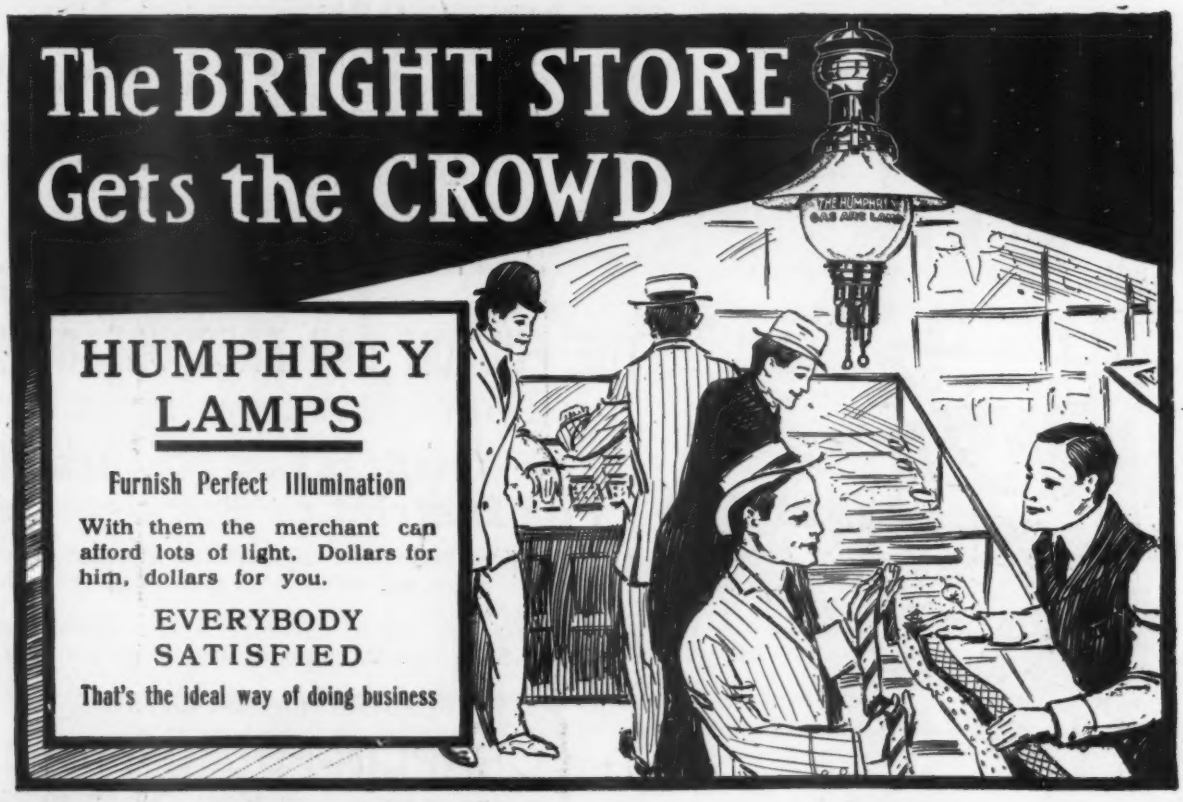

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Furnish Perfect Illumination

With them the merchant can afford lots of light. Dollars for him, dollars for you.

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FOR WATER AND GAS.
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GAS TAPPING MACHINES
—FOR—
Drilling and Tapping Pipe under Pressure
WITHOUT ANY ESCAPE OF GAS.
They are Strong and Compact.
Size of Combination Drills and Taps ¾ to 4-inch.
Machines Sent to any Gas Company for Thirty Days' Trial.
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Globe
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Cheapest and Best
THOUSANDS IN USE WITH INCANDESCENT BURNERS.
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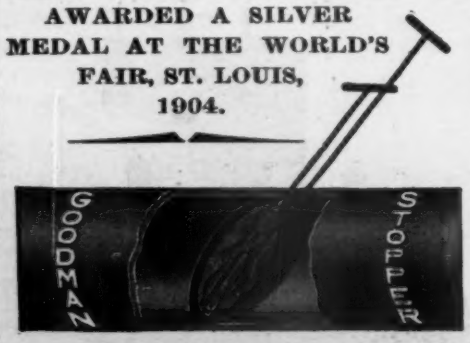
Chollar's System of Gas Purification.
THE PURIFIED GAS REVIVES THE FOULED OXIDE.

AWARDED A SILVER MEDAL AT THE WORLD'S FAIR, ST. LOUIS, 1904.



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Plans prepared and Estimates furnished at short notice.
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By HERMAN POOLE, F.C.S.
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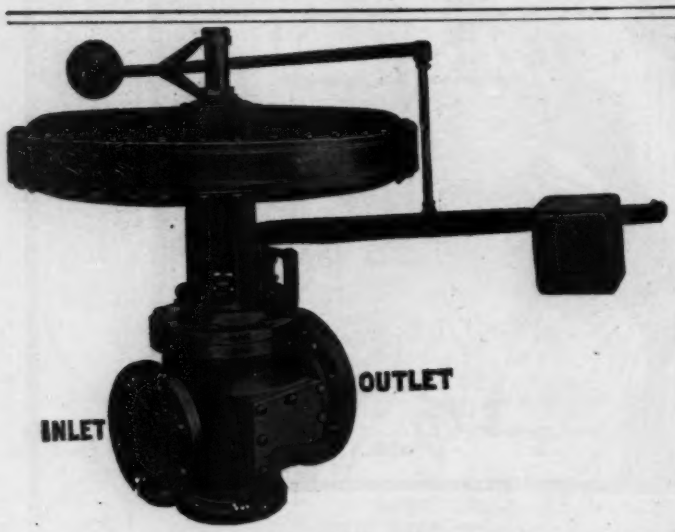

THE FULTON GAS PRESSURE GOVERNOR,
WITH AUTOMATIC SAFETY CUTOFF.
For Artificial or Natural Gas.
For District or Service Use.
Our DUPLEX SENSITIVE GOVERNOR, with Automatic Cutoff for district service, will reduce high pressure gas to inches of water without variation.
Absolutely safe and reliable. No complicated mechanism to get out of order. More than 20 years' experience with the largest gas companies.
SEND FOR LATEST CATALOG.
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For Sale by
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AMERICAN METER CO.,

NEW YORK, ST. LOUIS, PHILADELPHIA, SAN FRANCISCO, CHICAGO,

Photometrical and Experimental Apparatus.

PUBLIC LIGHTING TABLE.

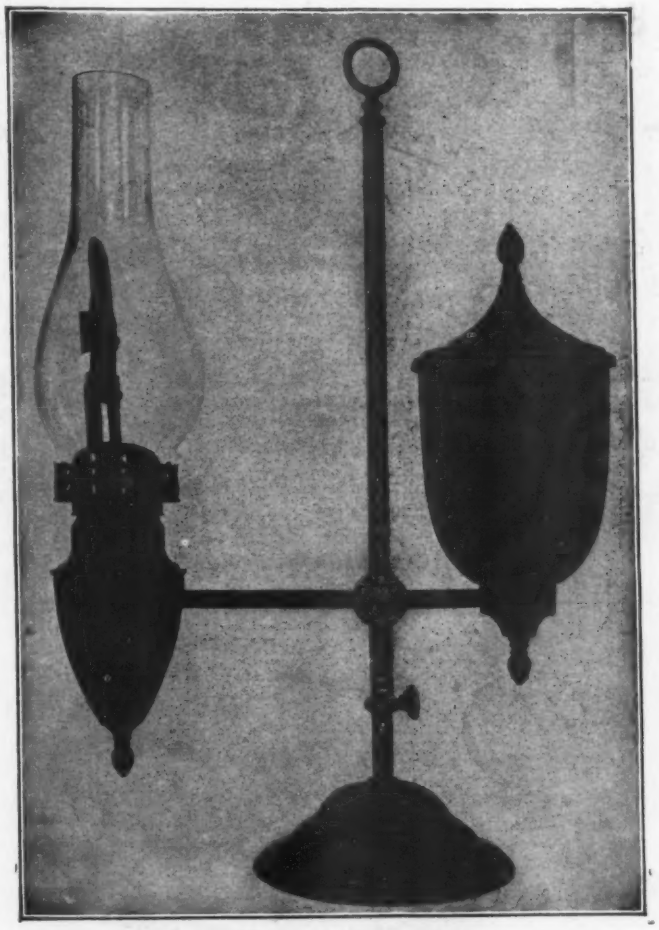
JANUARY, 1908.

Day of Week.	Date.	Table No. 1. FOLLOWING THE MOON. Light.	Extinguish.
Wed.	1	5.10 PM	6 20 AM
Thu.	2	5.10	6.20
Fri	3	5.10 NM	6.20
Sat.	4	5.10	6 20
Sun.	5	5.20	6.20
Mon.	6	5.20	6.20
Tue.	7	5.20	6.20
Wed.	8	9.40	6.20
Thu.	9	10 50	6.20
Fri.	10	11.50 FQ	6.20
Sat.	11	12.50 AM	6.20
Sun.	12	2.00	6.20
Mon.	13	3.00	6.20
Tue.	14	3.50	6.20
Wed.	15	4.50	6.20
Thu.	16	5.40	6.20
Fri.	17	No L.	No L.
Sat.	18	No L FM	No L.
Sun.	19	No L.	No L.
Mon.	20	5.30 PM	8.00 PM
Tue.	21	5.30	9.00
Wed.	22	5.30	10.00
Thu.	23	5.30	11.00
Fri.	24	5.30	12.00
Sat.	25	5 30	1.00 AM
Sun.	26	5.40 LQ	2.10
Mon.	27	5.40	3.20
Tue.	28	5.40	4.20
Wed.	29	5.40	6.10
Thu.	30	5.40	6.10
Fri.	31	5.40	6.10

TOTAL HOURS DURING 1908.

By Table No. 1.

	Hrs.Min.
January	228.30
February	187.30
March	192.00
April	160.10
May	155.10
June	138.00
July	155.50
August	173.40
September	185.20
October	214.00
November	218.10
December	226.40
Total, yr.	2235.00



THE ELLIOTT KEROSENE STANDARD PHOTOMETER LAMP.

❋❋❋

10-Candle Power.

❋❋❋

This lamp is a perfect substitute for the 10-candle Pentane Lamp hitherto used, and has the following advantages:

1st. It uses Standard Kerosene Oil (Pratt's Astral Oil or equivalent).

2d. It is remarkably steady. Will burn 24 hours continuously with less than 2 per cent. variation.

3d. It is much less dangerous than Pentane, which is a kind of gasolene.

4th. It is not easily affected by air currents in the photometer room.

5th. Since the lamp may burn continuously, the candle power of gas may be taken at any moment, if necessary. This insures steady illuminating power without waste of carburetting material.

6th. The first cost of the lamp brings it within the reach of even small gas works.

7th. Costs much less to maintain than a Pentane lamp or sperm candles doing the same service.

8th. Is not affected by the weather.

PUBLIC LIGHTING TABLE.

JANUARY, 1908.

Day of Week.	Date.	Table No. 2. NEW YORK CITY. All Night Lighting. Complete Lighting in One Hour From Time Given P. M.	Complete Extinguishing in 50 Minutes From Time Given A.M.
Wed.	1	4.12	6.27
Thu.	2	4.12	6.27
Fri.	3	4.12	6.27
Sat.	4	4.12	6.27
Sun.	5	4.12	6.27
Mon.	6	4.12	6.27
Tue.	7	4.12	6.27
Wed.	8	4.22	6.22
Thu.	9	4.22	6.22
Fri.	10	4.22	6.22
Sat.	11	4.22	6.22
Sun.	12	4.22	6.22
Mon.	13	4.22	6.22
Tue.	14	4.22	6.22
Wed.	15	4.32	6.17
Thu.	16	4.32	6.17
Fri.	17	4.32	6.17
Sat.	18	4.32	6.17
Sun.	19	4.32	6.17
Mon.	20	4.32	6.17
Tue.	21	4.32	6.17
Wed.	22	4.42	6.12
Thu.	23	4.42	6.12
Fri.	24	4.42	6.12
Sat.	25	4.42	6.12
Sun.	26	4.42	6.12
Mon.	27	4.42	6.12
Tue.	28	4.42	6.12
Wed.	29	4.47	6.07
Thu.	30	4.47	6.07
Fri.	31	4.47	6.07

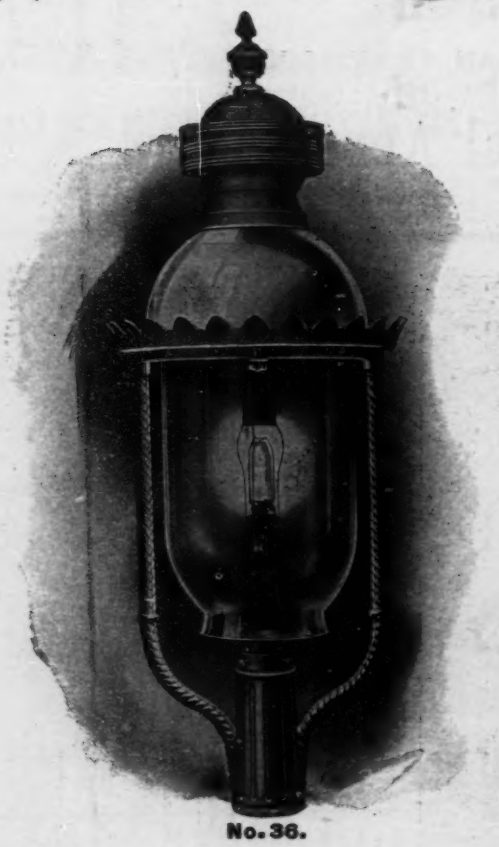
TOTAL HOURS DURING 1908.

	Hrs.Min.
January	481.50
February	329.15
March	351.50
April	341.50
May	233.05
June	218.10
July	282.55
August	254.55
September	292.25
October	420.45
November	374.30
December	411.05
	3992.35
Deduct on account of 50 min. extinguish'ag time	30.30
Total, yr.	3962.05

NEW YORK, 318 West 42d Street.
BOSTON, 820 Beacon Building.
PHILADELPHIA, Broad and Arch Streets.
ST. LOUIS, 712 Roe Building.
CHICAGO, 218 La Salle Street.
SAN FRANCISCO, 512 Oak Street.

WELSBACH STREET LIGHTING COMPANY

....OF AMERICA....



No. 36.

Controls and Operates the **Welsbach System of Street Lighting,**

Which includes its specially DESIGNED and PATENTED BURNER for PARK LIGHTING exclusively.

Uniformly SUCCESSFUL in 150 Cities and Towns.

By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

POINTS OF MERIT:

It is { Economical, Attractive, Successful, Up-to-date.

IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

Correspondence Solicited from Gas Companies and Others interested in Municipal and Outside Lighting.

No. 38.

INVERTED REFLEX GAS LIGHT
TRADE MARK

Succeeds and Excels the Electric Light at One-Quarter the Cost.

THE BURNER.

Elegance of Appearance.
Best Possible Material and Workmanship.
Perfect Combustion.
Lowest Gas Consumption.
Highest Candle Power.
Will Fit Any Fixture.
Will Not Flash Back.
Will Not Blacken Mantles.
Will Not Discolor Fixtures.
Will Not Discolor Ceilings.

THE MANTLE.

Best Welsbach Quality.
Extra Strong and Durable.
Highest Maintained Candle Power.
Rich Mellow Light.

THE GLASSWARE.

Highest Quality Imported.
Special Design Inner Cylinder (No. 317).
Protection from the Falling of Heated Particles.
Increases Candle Power.

Manufactured by

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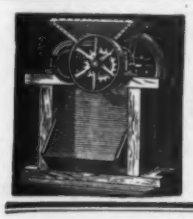

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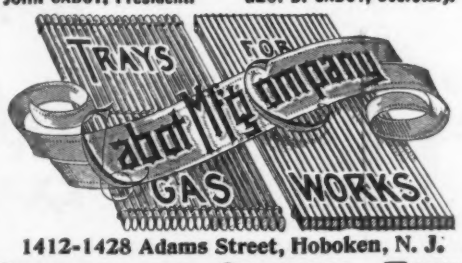

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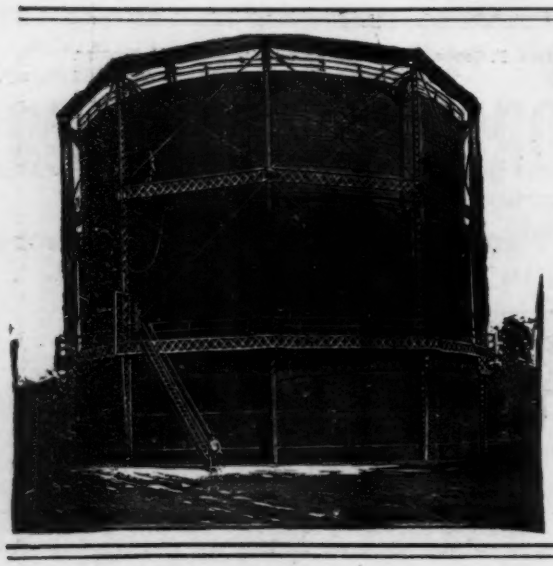

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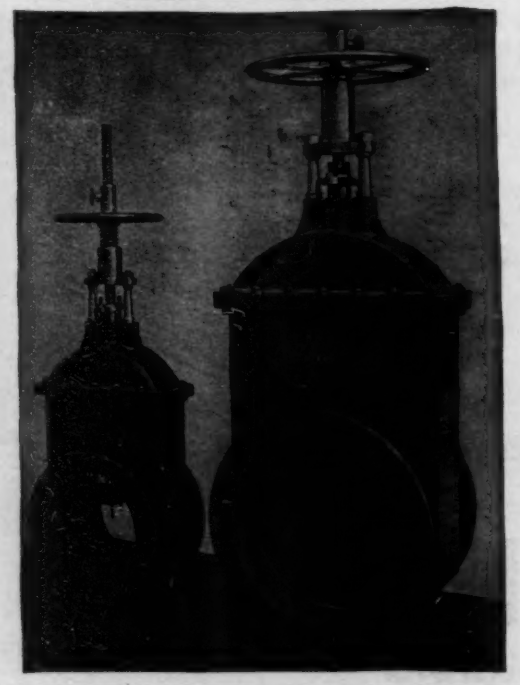

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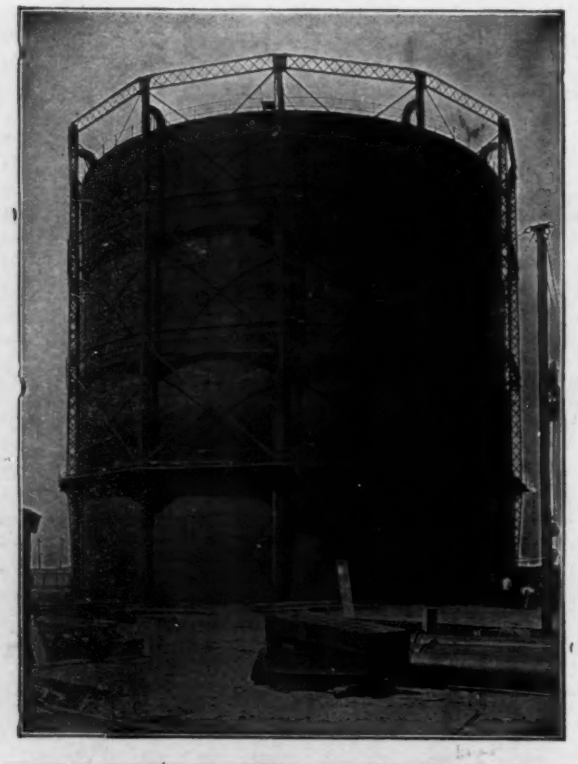

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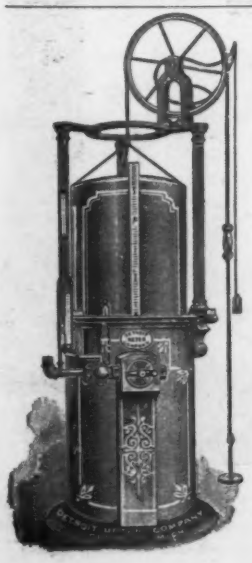

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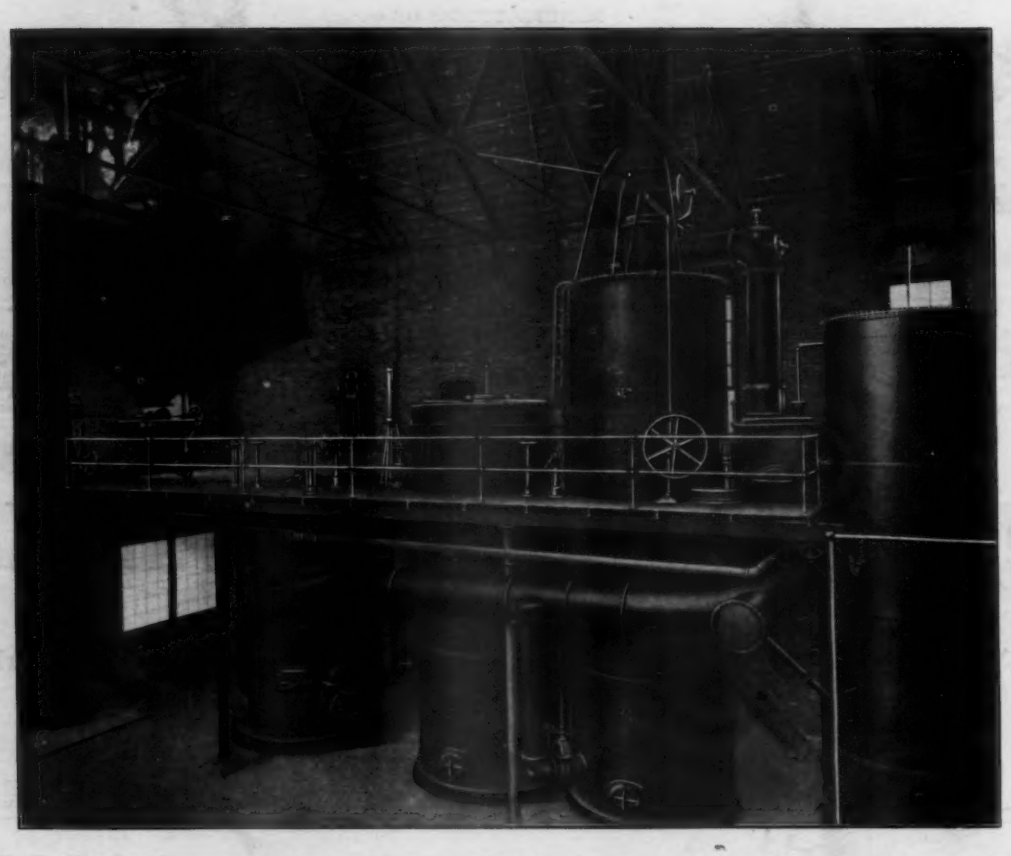
GAS ENGINEERS
EASTERN OFFICE NEW YORK CITY. WESTERN OFFICE SAN FRANCISCO.



8 FOOT 6 INCH EXTENDED CARBURETTER-SUPERHEATER WATER GAS APPARATUS.

FLOOR SPACE REQUIRED, INCLUDING ELEVATED COKE HOPPER, 19 FEET BY 60 FEET.

CAPACITY, 950,000 CUBIC FEET PER DIEM.

CONTRACTORS AND BUILDERS
EVERYTHING FOR A GAS PLANT